GOVERNMENT OF TAMILNADU

STANDARD SEVEN

MATHEMATICS

Term - I

Volume-2

A publication under Free Textbook Programme of Government of Tamil Nadu

Department of School Education

Untouchability is Inhuman and a Crime

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Government of Tamil Nadu

First Edition - 2019

Revised Edition - 2020, 2022, 2023

Reprint - 2021, 2024

(Published under New syllabus in Trimester Pattern)

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Content Creation

State Council of Educational Research and Training

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Printing & Publishing

Tamil NaduTextbook and Educational Services Corporation

www.textbooksonline.tn.nic.in

Mathematics is a unique symbolic language in which the whole world works and acts accordingly. This text book is an attempt to make learning of Mathematics easy for the students community.

Mathematics is not about numbers, equations, computations or algorithms; it is about understanding

— William Paul Thurston

The main goal of Mathematics in School Education is to mathematise the child's thought process. It will be useful to know how to mathematise than to know a lot of Mathematics.

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Chapter 1

NUMBER SYSTEM

$a \times (b+c) = (a \times b) + (a \times c)$

Learning objectives

- To understand the concept of addition and subtraction of integers.
- To understand the concept of multiplication and division of integers.
- To understand the properties of four fundamental operations applied to integers.
- To solve applied problems using the four fundamental operations on integers.

Recap

Integers are the collection of natural numbers, zero and negative numbers.

We denote this collection by $\mathbb{Z}$.

Negative integers are represented on the number line to the left of zero and positive integers to the right of zero.

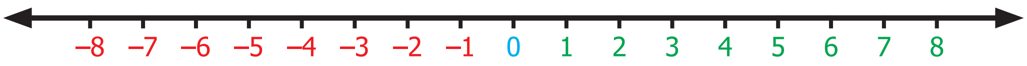

Fig. 1.1

Every integer on this number line is placed in an increasing order from left to right.

The integers at each point A, B, C, D in the figure given below are $A = +3$, $B = +7$, $D = -1$ and $C = -5$.

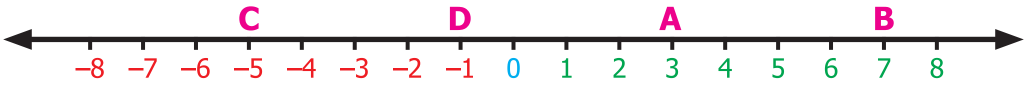

Fig. 1.2

Try these

1. Write the following integers in ascending order:
   –5, 0, 2, 4, –6, 10, –10
2. If the integers –15, 12, –17, 5, –1, –5, 6 are marked on the number line then the integer on the extreme left is ______________.
3. Complete the following pattern:
   ____, –40, ____, ____, –10, 0, ____, 20, 30, ____, 50.
4. Compare the given numbers and write "<", ">" or "=" in the boxes.
   (a) –65 ☐ 65 (b) 0 ☐ 1000 (c) –2018 ☐ –2018
5. Write the given integers in descending order :
   –27, 19, 0, 12, –4, –22, 47, 3, –9, –35

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1.1 Introduction

In class VI, we studied how to compare and arrange integers. Now, let us try to add and subtract integers.

We know 7–5 = 2. But, what is 5–7? Let us try to take away 7 from 5 using the number line. As the integers on the number line increases from left to right, we should move to the left of zero to do this subtraction.

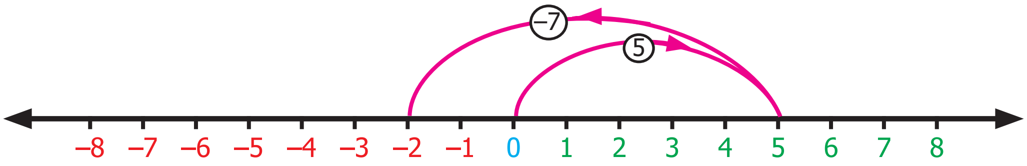
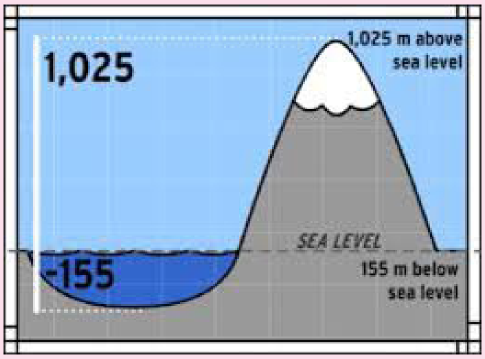


Fig. 1.3

Is it really necessary to do this? Have you come across any such situations in life? Yes, there are situations like increase or decrease in temperature, amount deposited and withdrawn from an account, profit and loss in a business are all instances where integers are involved.

MATHEMATICS ALIVE – NUMBER SYSTEM IN REAL LIFE



Mountain, below and above sea level.

Termperature is < 0°C in Antarctica and Arctic, >0°C in Equator.

1.2 Addition of Integers

The number line is a simple tool to visualise addition of integers. Let us do an activity with the number line.

Activity

Imagine that the number line is a road with markers on it. We are allowed to step forward or backward on this road. One step taken is equal to one unit of number. Initially we start at zero and face positive direction. We step forward for positive integers and backward for negative integers. We maintain the same positive direction for addition operation.

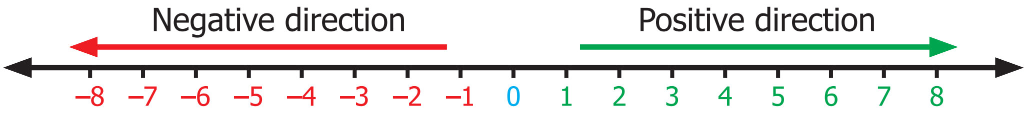


Fig. 1.4

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To add (+5) and (–3), We start at zero facing positive direction and move five steps forward to represent (+5). Since the operation is addition we maintain the same direction and move three units backward to represent (–3). We land at +2. So, (+5)+(–3)=2. This is shown in Fig.1.5.

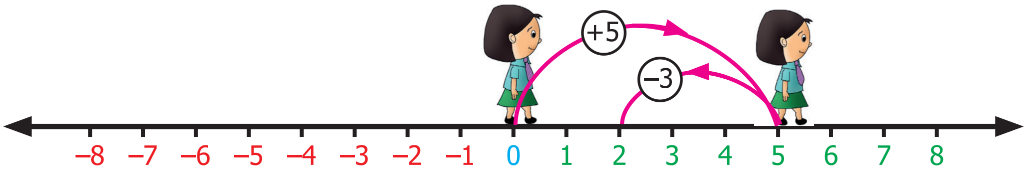


Fig. 1.5

Proceeding in the same way let us try another example. Find the sum of (–6) and (–4). We start at zero facing positive direction continuing in the same direction and move 6 units backward to represent (–6) and in the same direction move 4 units backward to represent (–4). We land at (–10).

Therefore, (–6)+(–4)=–10

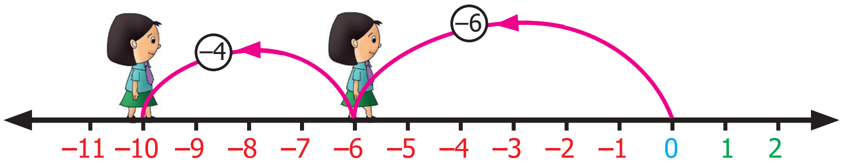


Fig. 1.6

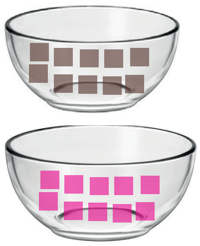
Try this

Find the value of the following using the number line activity:

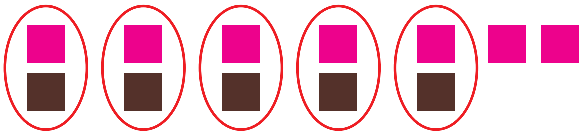
(i) (–4) + (+3)   (ii) (–4) + (–3)   (iii) (+4) + (–3)

Activity

There are two bowls with tokens of two different colours brown and pink. Let us denote one brown token by (+1) and one pink token by (–1). A pair of tokens, brown (+1) and pink (–1), will denote zero [1+(–1)=0]



To add two integers, we pick the required number of tokens and form possible zero pairs. The remaining number of tokens left after pairing is the sum of the two integers.



(–7)
(+5)
–2

To add (–7) and (+5) we pick 7 pink tokens and 5 brown tokens. We form zero pairs from the tokens as above. We can form 5 zero pairs. Then we are left with 2 pink tokens. Hence, $(-7)+(+5)=-2$.

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(–3) (+) (–4) = –7

To add (–3) and (–4) we pick 3 pink tokens first and 4 pink tokens later. The total number of tokens is 7 pink tokens. There are no zero pairs. So, the sum of (–3) and (–4) is (–7). Teacher can give different integers and ask them to add using tokens.

Note

1. When we add two integers of the same sign the sum will also be an integer of the same sign. When we add two integers of different sign, the sum will be the difference between the two integers and have the sign of the integer with greater value.
2. The integer without sign represents positive integer.

Example 1.1

Add the following integers using number line (i) 10 and –15 (ii) –7 and –9

Solution Let us add the intergers using number line

(i) 10 and –15

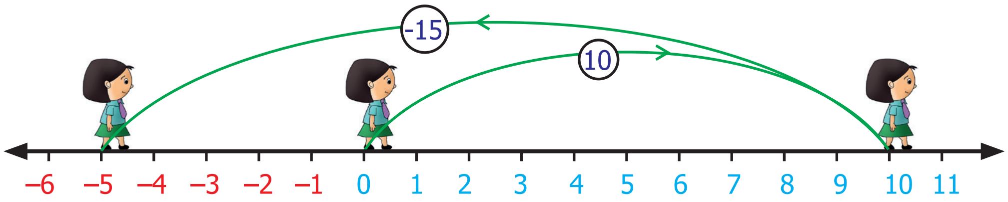

Fig. 1.7

On the number line we first start at zero facing positive direction and move 10 steps forward, reaching 10. Then we move 15 steps backward to represent –15 and reach at –5. Thus, we get 10 + (–15) = –5.

(ii) –7 and –9

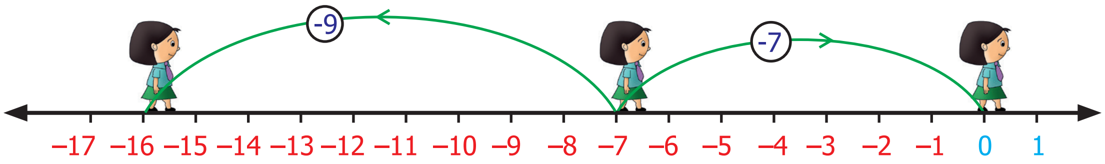

Fig. 1.8

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On the number line we first start at zero facing positive direction and move 7 steps backward, reaching –7. Then we move 9 steps backward to represent –9 and reach at –16. Thus, we get (–7) + (–9) = –16.

Example 1.2

Add (i) (–40) and (30) (ii) 60 and (–50)

Solution (i) (–40) and (30)

–40 + 30 = –10

(ii) 60 and (–50)

60 + (–50) = 60 – 50 = 10

Example 1.3

Add: (i) (–70) and (–12) (ii) 103 and 39.

Solution (i) (–70) + (–12) = –70 – 12 = – 82

(ii) 103 + 39 = 142

Example 1.4

A submarine is at 32 feet below the sea level. Then it moves up 8 feet. Find the depth of the submarine.

Solution A submarine is 32 feet below sea level.

Therefore, it is represented by –32

Next it moves up 8 feet.

Moves above is represented as +8

The depth of the submarine = –32 + 8 = –24

Therefore, the submarine is located at 24 feet below the sea level.

Example 1.5

Sita saved ₹ 225.00 and she has spent ₹ 400 on credit basis for the purchase of stationery. Find her due amount.

Solution The amount Sita has ₹ 225

The amount spent for stationery on credit = ₹ 400

The due amount to be paid = 225 – 400 = – 175

Therefore, Sita has to pay ₹ 175

Example 1.6

From the ground floor a man went up six floors and came down six floors. In which floor is he now?

Solution Starting point = Ground floor

Number of floors climbed up = +6

Number of floors climbed down = –6

Now the landing point = +6 – 6 = 0 (ground floor)

1.2.1 Properties of Addition

In class VI, we have studied that the collection of whole numbers is closed under the addition operation. The sum of two whole numbers is always a whole number. Does this property hold for the collection of integers also?

Complete the given table and check whether the sum of two integers is an integer or not?

(i) $7+(-5)=$	(ii) $(-6)+(-13)=$	(iii) $25+9=$
(iv) $(-12)+4=$	(v) $41+32=$	(vi) $(-19)+(-15)=$
(vii) $52+(-15)=$	(viii) $(-7)+0=$	(ix) $0+12=$
(x) $14+0=$	(xi) $(-6)+(-6)=$	(xii) $(-27)+0=$

We observe that in all the above cases the sum of two integers is an integer. Since addition of integers is an integer, we say that integers are closed under addition. This property is known as "closure property" of integers on addition.

Therefore, for any two integers a, b; $a+b$ is also an interger.

We observe one more property of integers. The order in which we add two integers does not matter. For example, $12+(-13)$ is the same as $(-13)+(12)$. Also $(-7)+(-5)$ is the same as $(-5)+(-7)$.

This property is known as "commutative property" of integers.

Therefore, for any two integers a, b; $a+b = b+a$.

What happens when we add three integers? For example, will $(-7)+(-2)+(-9)$ give the same value when they are added in any way of grouping.

Let us check by grouping the integers as [(–7)+(–2)]+ (–9) and (–7) + [(–2) + (–9)]. First let us find the value of [(–7)+(–2)]+ (–9).

$[(-7)+(-2)]+(-9) = (-9) + (-9) = -9 - 9 = -18$

Let us illustrate this with the number line : $[(-7)+(-2)]+(-9)$ can be represented as

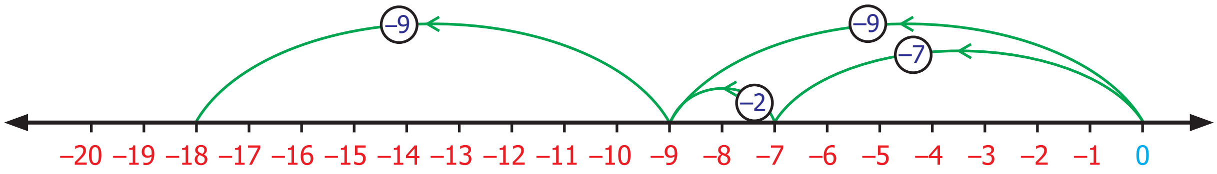

Fig. 1.9

$$[(-7)+(-2)]+(-9) = -18$$

Then we will find the value of (–7) + [(–2) + (–9)]

$(-7) + [(-2) + (-9)] = (-7) + (-11) = -7 - 11 = -18$

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(−7) + [(−2) + (−9)] can be represented on the number line as below.

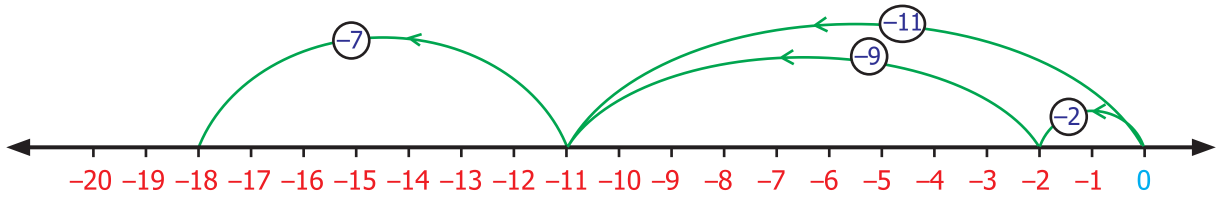

Fig. 1.10

$$(-7)+\left[(-2)+(-9)\right] = (-18)$$

We reach the same number −18 in both the cases. Hence, regrouping of integers does not change the value of the sum. This property is known as "associative property" under addition.

Therefore, for any three integers $a, b, c;\ a+(b+c) = (a+b)+c$

The collection of integers has positive, negative integers and zero. Have you noticed that zero is neither positive nor negative integer. What happens when we add zero to an integer?

For example, we observe that 7 + 0 = 7, −3 + 0 = −3, −27 + 0 = −27,
−79 + 0 = −79, 0 + (−69) = −69, 0 + (−85) = −85.

From the above it is clear that whenever zero is added to an integer, we get the same integer. Due to this property, zero is called the identity with respect to addition or "additive identity" of the collection of integers.

Therefore, for any integers a, $a + 0 = a = 0 + a$

The additive identity zero separates the number line into positive and negative integers. We have +1 and–1,+5 and −5,−15 and +15, etc. on opposite sides of the number line that are equidistant from zero. Such integers on either side of zero are called "opposites" of each other. In fact, we find that the "opposites" added together always give the value zero.

For example, $(-15)+15=0$, $21+(-21)=0$. This property of integers is named as "additive inverse". (−15) is the additive inverse of 15 because their sum is zero. In the same way, 21 is the additive inverse of -21. Either of the pair of opposites is known as the "additive inverse" of the other.

Therefore, for any integer a, $-a$ is the additive inverse.

$a+(-a) = 0 = (-a)+a$

Try these

1. Fill in the blanks:

   (i) $20+(-11)=$ ___ $+20$ (ii) $(-5)+(-8)=(-8)+$ ___ (iii) $(-3)+12=$ ___ $+(-3)$

2. Say true or false.

   (i) $(-11)+(-8) = (-8)+(-11)$ (ii) $-7+2=2+(-7)$ (iii) $(-33)+8=8+(-33)$

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3. Verify the following:

(i) $[(-2)+(-9)]+6=(-2)+[(-9)+6]$ (ii) $[7+(-8)]+(-5)=7+[(-8)+(-5)]$

(iii) $[(-11)+5]+(-14)=(-11)+[5+(-14)]$

(iv) $(-5)+[(-32)+(-2)]=[(-5)+(-32)]+(-2)$

4. Find the missing integers:

(i) $0+(-95)=$ ______ (ii) $-611+$ _____ $=-611$

(iii) _____ +0= ______ (iv) $0+(-140)=$ _____

5. Complete the following:

(i) $-603+603=$ ___ (ii) $9847+(-9847)=$ ___ (iii) $1652+$ ___ $=0$

(iv) $-777+$ ___ $=0$ (v) ___ $+5281=0$

Example 1.7 (i) Are 120 + 51 and 51 + 120 equal?

(ii) Are $(-5)+[(-4)+(-3)]$ and $[(-5)+(-4)]+(-3)$ equal?

Solution

(i) When we add, 120 + 51 = 171 ; 51 + 120 = 171

In both the cases we get same answer. This means that integers can be added in any order. Hence, addition of integers is commutative.

(ii) $(-5)+[(-4)+(-3)]$ and $[(-5)+(-4)]+(-3)$

In $(-5)+[(-4)+(-3)]$, (-4) and (-3) are added first and their result is then added with (-5).

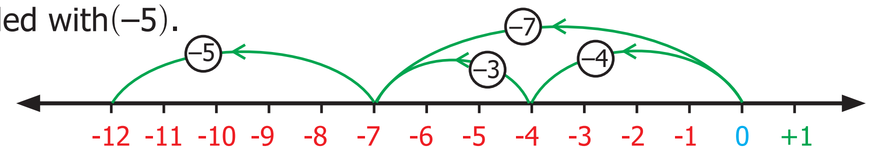

Fig. 1.11

$(-5)+[(-4)+(-3)]=-12$

Whereas in $[(-5)+(-4)]+(-3)$, (-4) and (-3) are added first and then the result is added with (-5)

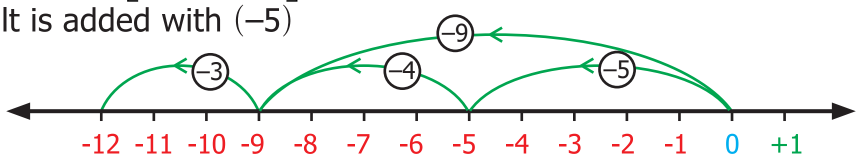

Fig. 1.12

$[(-5)+(-4)]+(-3)=-12$

In both the cases, we get -12

That is $(-5)+[(-4)+(-3)]=[(-5)+(-4)]+(-3)$

So, addition is associative.

Example 1.8 Find the missing integers (i) $0+(-2345)=$ ______ (ii) $23479+$ _____ $=0$

Solution (i) $0+(-2345)=-2345$

(ii) $23479+(-23479)=0$

Therefore, additive inverse of 23479 is -23479

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Example 1.9

Mention the property for the following equations:

(i) $(-45)+(-12)=-57$

(ii) $(-15)+7=(7)+(-15)$

(iii) $-10+3=-7$

(iv) $(-7)+(-5)=(-5)+(-7)$

(v) $(-7)+[(-4)+(-3)]=[(-7)+(-4)]+(-3)$

(vi) $0+(-7245)=-7245$

Solution

(i) Closure Property

(ii) Commutative Property

(iii) Closure Property

(iv) Commutative Property

(v) Associative Property

(vi) Additive Identity

Exercise 1.1

1. Fill in the blanks

(i) $(-30)+____ = 60$

(ii) $(-5)+____ = -100$

(iii) $(-52)+(-52)=____$

(iv) $____+(-22)=0$

(v) $____+(-70) = 70$

(vi) $20+80+____=0$

(vii) $75+(-25)=____$

(viii) $171+____=0$

(ix) $[(-3)+(-12)]+(-77)=____+[(-12)+(-77)]$

(x) $(-42)+[____+(-23)]=[____+15]+____$.

2. Say true or false.

(i) The additive inverse of (–32) is (–32)

(ii) (−90)+(−30) = 60

(iii) (−125)+25 = −100

3. Add the following

(i) 8 and –12 using number line

(ii) (–3) and (–5) using number line

(iii) $(-100)+(-10)$

(iv) $20+(-72)$

(v) $82+(-75)$

(vi) $-48+(-15)$

(vii) $-225+(-63)$

4. Thenmalar appeared for competitive exam which has negative scoring of 1 mark for each incorrect answer. In paper I she answered 25 questions incorrectly and in paper II, 13 questions incorrectly. Find the total reduction of marks.

5. In a quiz competition, Team A scored +30,–20, 0 and team B scored –20, 0, +30 in three successive rounds. Which team will win? Can we say that we can add integers in any order?

6. Are $(11+7)+10$ and $11+(7+10)$ equal? Mention the property.

7. Find 5 pairs of integers that add up to 2.

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Objective type questions

8. The temperature at 12 noon at a certain place was 18° above zero. If it decreases at the rate of 3° per hour at what time it would be 12° below zero?

   (i) 12 mid night (ii) 12 noon

   (iii) 10 am (iv) 10 pm

9. Identify the problem with negative numbers as its answer:

   (i) $-9+(-5)+6$ (ii) $18 + (-12) - 6$

   (iii) $-4+2+10$ (iv) $10+(-4)+8$

10. $(-10)+(+7) =$ ____

    (i) +3 (ii) –3 (iii) –17 (iv) +17

11. $(-8)+10+(-2) =$ ____

    (i) 2 (ii) 8 (iii) 0 (iv) 20

12. $20+(-9)+9 =$ ____

    (i) 20 (ii) 29 (iii) 11 (iv) 38

1.3 Subtraction of Integers

Let us learn subtraction of integers using number line.

Let us try to subtract integers using the number line activity we studied earlier. We should follow the same instructions as before but whenever we need to subtract, we turn towards the negative side.

To subtract (+4) from (+7)

We start at zero facing positive direction. Moves 7 units forward to represent +7 then turn towards the negative side for the operation of subtraction and move +4 units forward to represent +4. We reach the integer +3. So, $(+7)-(+4)=+3$.

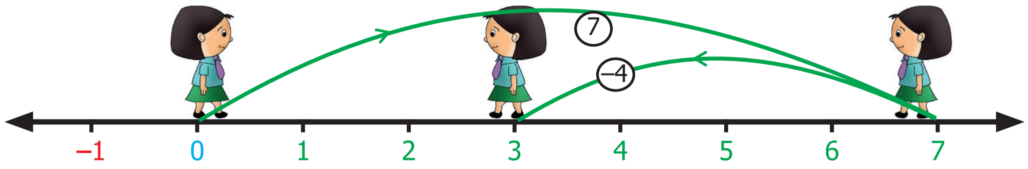

Fig. 1.13

Let us find $(-8)-(-5)$.

We start at zero facing positive direction. Move 8 units backward to represent (–8). Then turn towards the negative side and move 5 units backwards. We reach –3. We have $(-8)-(-5) = (-3)$.

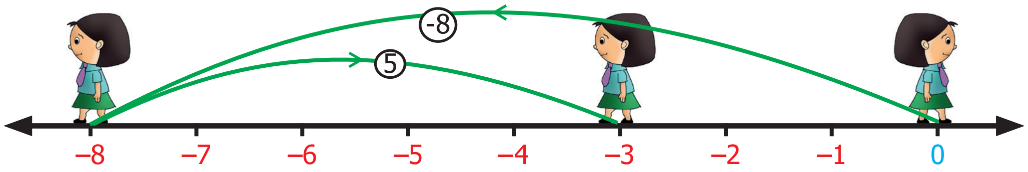

Fig. 1.14

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Now, let us learn subtraction of integers in another way.

Observe the following patterns :

$$7-2=5\,; \qquad 7-1=6\,; \quad 7-0=7$$

What will happen if we extend this to negative integers?

$$7-(-1)=8\,;\ \ 7-(-2)=9\,;\ \ 7-(-3)=10$$

We shall see some more patterns.

$$20-2=18\,;\ \ 20-1=19\,;\ \ 20-0=20\,;\ \ 20-(-1)=21\,; \qquad 20-(-2)=22$$

We can see from the above patterns that while subtracting consecutive negative integers from 7 and 20 the difference increase consecutively.

It is clear that subtraction of negative integers gives increase in the difference. For example $7-(-2)=9$. Hence, subtraction of -2 is equivalent to addition of 2, which is the additive inverse of -2. That is, 7+2 =9.

So, to subtract a negative integer from an integer we add the additive inverse of the integer which is to be subtracted.

For example, subtract (–5) from 7.

7 – (–5)

To subtract (-5) we can add additive inverse of (–5) that is 5 with 7

Therefore, 7 – (–5) = 12

Try these

1. Do the following by using number line.
   (i) (–4) – (+3) (ii) (–4) – (–3)

2. Find the values and compare the answers.
   (i) (–6) – (–2) and (–6) + 2
   (ii) 35 – (–7) and 35 + 7
   (iii) 26 – (+10) and 26 + (–10)

3. Put the suitable symbol <, > or = in the boxes.
   (i) −10 − 8 □ −10 +8 (ii) (−20) + 10 □ (−20) − (−10)
   (iii) (−70) − (−50) □ (−70) −50 (iv) 100 − (+100) □ 100 − (−100)
   (v) −50 −30 □ −100 + 20

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Note

Every subtraction statement has a corresponding addition statement. For example, $8-5=3$ is a subtraction statement. This can be seen as the addition statement $3+5=8$ In the same way, $(-8)-(-5)=-3$ is a subtraction statement which can be written as the addition statement $(-8)=(-3)+(-5)$.

Example 1.10 Subtract the following using the number line.

(i) $-3-(-2)$ (ii) $+6-(-5)$

Solution

(i) $-3-(-2)$

To subtract −2 from −3 using number line,

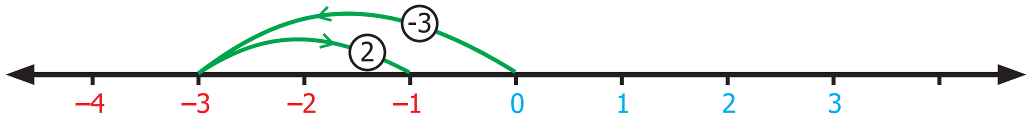

Fig. 1.15

Therefore, $-3-(-2) = -3+2 = -1$

(ii) $+6-(-5)$

To subtract −5 from 6 using number line,

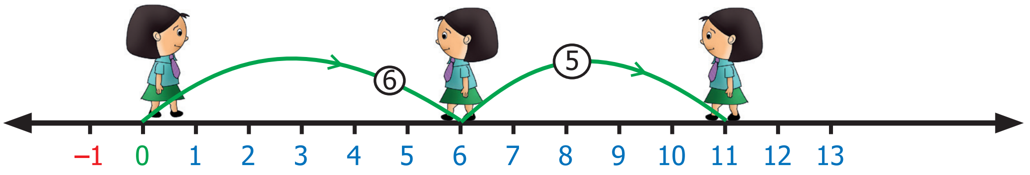

Fig. 1.16

Therefore, $+6-(-5) = +6+5 = 11$.

Now, let us see how to subtract negative integers using additive inverse.

Example 1.11

(i) Subtract (-40) from 70 (ii) Subtract (-12) from (-20)

Solution

(i) $70-(-40)$

$=70+$ (additive inverse of -40)

$=70+40$

$=110$.

(ii) $(-20)-(-12)$

$=(-20)+$(additive inverse of (-12))

$=(-20)+12$

$=-8$

Example 1.12

Find the value of : (i) $(-11)-(-33)$ (ii) $(-90)-(-50)$

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Solution

(i) $(-11)-(-33)$
$= (-11)+(+33)$
$= 22$

(ii) $(-90)-(-50)$
$= -90-(-50)$
$= -90+50$
$= -40$

Example 1.13

Chitra has ₹ 150. She wanted to buy a bag which costs ₹ 225. How much money does she need to borrow from her friend?

Solution

Amount with Chitra = ₹ 150
Cost of bag = ₹ 225
Amount to be borrowed = 225 − 150
= ₹ 75

Example 1.14

What is the balance in Chezhiyan's account as a result of a purchase for ₹ 1079, if he had an opening balance of ₹ 5000 in his account?

Solution

Opening balance = ₹ 5000
Debit amount = ₹ 1079 (−)
Balance amount = ₹ 3921

Example 1.15

The temperature at Srinagar was −3°C on Friday. If the temperature decreases by 1°C next day, then what is the temperature on that day?

Solution

The temperature at Srinagar was −3°C on Friday. If the temperature decreases by 1°C then, temperature on the next day = −3°C – 1°C = −4°C

Example 1.16

A submarine is at 300 feet below the sea level. If it ascends to 175 feet, what is its new position?

Solution

Initial position of submarine = 300 feet below
= -300 feet
Distance ascended by submarine = 175 feet
= + 175 feet
New position of submarine = (−300) + (+175)
= −125

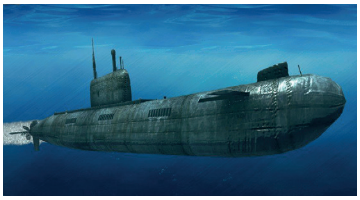

Fig. 1.17

That is, the submarine is 125 feet below the sea level.

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1.3.1 Properties of Subtraction

We can test whether all the properties of integers that are true for addition still hold for subtraction or not.

Recall that subtraction of two whole numbers did not always result in a whole number. However, this extended form of integers is enough to make sure that the difference of two integers is also an integer. For example, $(-7)-(-2)$ is an integer, $(-5)+14$ is an integer and $0-(-8)$ is an integer. From these examples we observe that the collection of integers is "closed", that is, the difference of two integers is always an integer.

Therefore, for any two integers a, b ; $a-b$ is also an integer.

What about the other properties? Can you see that $(-2)-(-5)=3$ but $(-5)-(-2)=-3$ Also, $10-(-5)=15$ but $(-5)-10=-15$. Therefore, changing the order of integers in subtraction will not give the same value. Hence, the commutative property does not hold for subtraction of integers.

Therefore, for any two integers a, b ; $a-b \neq b-a$.

Try these

1. Fill in the blanks.
   (i) $(-7)-(-15)=$____ (ii) $12-$___ $=19$ (iii) ___ $-(-5)=1$
2. Find the values and compare the answers.
   (i) 15 – 12 and 12 –15 (ii) –21 –32 and –32 –(–21)

Think

Is assosiative property true for subtraction of integers?

Take any three examples and check.

Exercise 1.2

1. Fill in the blanks
   (i) $-44+$___ $=-88$ (ii) ____ $-75=-45$ (iii) ____ $-(+50)=-80$
2. Say true or false
   (i) $(-675)-(-400)=-1075$
   (ii) $15-(-18)$ is the same as $15+18$
   (iii) $(-45)-(-8)=(-8)-(-45)$
3. Find the value of the following
   (i) –3–(–4) using number line (ii) 7–(–10) using number line
   (iii) 35 – (–64) (iv) –200 – (+100)
4. Kabilan was having 10 pencils with him. He gave 2 pencils to Senthil and 3 to Karthik. Next day his father gave him 6 more pencils, from that he gave 8 to his sister. How many pencils are left with him?

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5. A lift is on the ground floor. If it goes 5 floors down and then moves up to 10 floors from there. Then in which floor will the lift be?

6. When Kala woke up, her body temperature was 102°F. She took medicine for fever. After 2 hours it was 2°F lower. What was her temperature then?

7. What number should be added to (–17) to get (–19)?

8. A student was asked to subtract (–12) from (–47). He got -30. Is he correct? Justify.

Objective type questions

9. $(-5)-(-18)=$ ____

 (i) 23 (ii) –13 (iii) 13 (iv) –23

10. $(-100)-0+100=$ ____

 (i) 200 (ii) 0 (iii) 100 (iv) –200

1.4. Multiplication of Integers

Situation 1

Ramani and Ravi are playing with pebbles in a heap. Ramani is adding some pebbles to the heap while Ravi removes some pebbles. First, Ramani adds 3 pebbles. Then she adds 3 more pebbles. She repeats this 2 more times. Can you say how many pebbles she added in all? Since adding pebbles is positive we can write $(+3)+(+3)+(+3)+(+3)=+12$ or $4\times(+3)=12$

The total number of pebbles added is 12.

Ravi takes out 5 pebbles three times. If we represent "taking out" as a negative integer then $(-5)+(-5)+(-5)=-15$ or we can simply put it as $(-5)\times 3=-15$. Ravi has removed 15 pebbles from the heap. This illustrates that multiplication of negative integers is also repeated addition just like positive integers or whole numbers.

We can draw a number line and visualise the above multiplication of integers as repeated addition.

$4\times 3=12$ (3 is added four times).

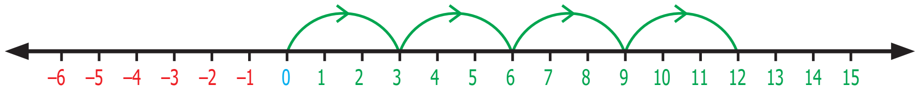

Fig. 1.18

$(-5)\times 3=-15$ ((–5) is added three times).

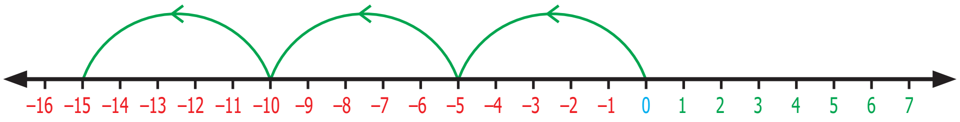

Fig. 1.19

We have no difficulty to understand that a positive integer like (+7) multiplied by another positive integer like (+8) is positive (+56). Also, a positive integer like +7 multiplied by a negative integer like –5 is –35 and $+5\times -7=-35$. But what about a negative integer

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(-3) multiplied with another negative integer -5? To understand this, let us observe the following pattern.

$$(-5)\times 3 = -15$$
$$(-5)\times 2 = -10$$
$$(-5)\times 1 = -5$$
$$(-5)\times 0 = 0$$
$$(-5)\times(-1) = +5$$
$$(-5)\times(-2) = +10$$
$$(-5)\times(-3) = +15$$

Note that how in each step the number increase by 5 from -15 to -10, from -10 to -5, from -5 to 0. Therefore, the next number in the pattern will be +5 only and not -5. Similarly $(-5)\times(-2)$ is a positive integer 10. So, the product of two negative integers is always a positive integer.

Try these

1. Find the product of the following

   (i) $(-20)\times(-45) =$ _____ (ii) $(-9)\times(-8) =$ _____

   (iii) $(-30)\times 40\times(-1) =$ _____ (iv) $(+50)\times 2\times(-10) =$ _____

2. Complete the following table by multiplying the integers in the corresponding row and column headers.

X	-3	-2	-1	0	1	2	3
-3							
-2							
-1							
0							
1							
2							
3							

3. Which of the following is incorrect?

   (i) $(-55)\times(-22)\times(-33) < 0$

   (ii) $(-1521)\times 2511 < 0$

   (iii) $2512 - 1252 < 0$

   (iv) $(+1981)\times(+2000) < 0$

Think

Can you express the product 15 × 16 as sum or difference of integers?

Yes, here are 4 ways to compute $15\times 16 = +240$.

(i) $15\times 16 = (10+5)\times(10+6) = 100+60+50+30 = 240$

(ii) $15\times 16 = (20-5)\times(10+6) = 200+120+(-50)+(-30) = 240$

(iii) $15\times 16 = (10+5)\times(20-4) = 200+(-40)+100+(-20) = 240$

(iv) $15\times 16 = (20-5)\times(20-4) = 400+(-80)+(-100)+\boxed{20} = 240$

From the above pattern one can determine the product of two positive integers, two negative integers, one positive integer with one negative integer.

Example 1.17 Find the value of :

(i) (–35) × (–11) (ii) 96 × (–20) (iii) (–5) × 12

(iv) 15 × 5 (v) 999 x 0

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Solution

(i) (–35) × (–11) = 385 (ii) 96 × (–20) = – 1920

(iii) (–5) × 12 = –60 (iv) 15 × 5 = 75

(v) 999 x 0 = 0

Example 1.18 A fruit seller sold 5kg of mangoes at a profit of ₹ 15 per kg and 3kg of apples at a loss of ₹ 30 per kg. Find whether it is a profit or loss.

Solution

Profit of 1kg mangoes = ₹ 15
Profit of 5kg mangoes = 15 × 5
= ₹ 75
Loss of 1kg apples = ₹ 30
Loss of 3kg apples = 30 × 3
= ₹ 90
Loss = 90 – 75
= ₹ 15

Example 1.19 Browsing rates in an internet centre is ₹ 15 per hour. Nila works on the internet for 2 hours in a day for 5 days in a week. How much does she pay?

Solution

Number of hours spent on an internet for a day = 2 hrs
Therefore, number of hours spent on the internet for 5 days = 5 × 2
= 10 hrs
Cost of browsing per hour = ₹ 15
Cost of browsing for 10 hours = 15 × 10
Therefore, the amount paid by Nila for 5 days = ₹ 150

1.4.1 Properties of Multiplication of Integers

Recall that multiplication of whole numbers had the closure property. If we test this property for integers we find $(-7)\times(-2)=+14$, $(-6)\times5=-30$, $4\times(-9)=-36$. Thus, product of any two integers is always an integer. "Closure property" holds for integers.

Therefore, for any two integers a, b ; $a\times b$ is also an integer.

Consider the examples, $21\times(-5)=-105$ is the same as $(-5)\times21=-105$. The product $(-9)\times(-8)=+72$, $(-8)\times(-9)=72$. In both the cases the product is the same integer. So, changing the order of multiplication does not change the value of the product. Hence, we conclude that multiplication of integers are "commutative".

Therefore, for any two integers a, b ; $a\times b = b\times a$.

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To verify that multiplication of integers is associative, let us check whether $(-5)\times[(-9)\times(-12)]$ and $[(-5)\times(-9)]\times(-12)$ are equal.

$(-5)\times[(-9)\times(-12)]=(-540)$ and $[(-5)\times(-9)]\times(-12) = (-540)$.

Hence, "associative" property is true for mutliplication of integers.

Therefore, for any three integers a, b, c ; $(a\times b)\times c = a\times(b\times c)$.

Just as zero added to a integer leaves it unchanged, integer 1 multiplied with any integer leaves the integer unaltered. For example, $57\times1=57$, and $1\times(-62)=-62$. We say that the integer 1 is the identity for multiplication of integers or "multiplicative identity".

Therefore, for any integer a; $a \times 1 = 1 \times a = a$.

Try these

1. Find the product and check for equality :
   (i) $18\times(-5)$ and (–5) × 18
   (ii) 31 × (–6) and (–6) × 31
   (iii) 4 × 51 and 51 × 4
2. Prove the following :
   (i) (–20) × (13×4) = $[(-20)\times13]\times4$
   (ii) $[(-50)\times(-2)]\times(-3)=(-50)\times[(-2)\times(-3)]$
   (iii) $[(-4)\times(-3)]\times(-5)=(-4)\times[(-3)\times(-5)]$

Note

Consider an example, (–7) × (–6) × (–5) × (–4).

Let us try to do the above multiplication of integer,

$$(-7)\times(-6)\times(-5)\times(-4) = [(-7)\times(-6)]\times[(-5)\times(-4)] = (+42)\times(+20) = +840$$

From the above example, we see that the product of four negative integers is positive. What will happen if we multiply odd number of negative integers.

Let us consider another example, (–7) × (–3) × (–2).

Multiplying the above integers, we get

$$(-7)\times(-3)\times(-2) = [(-7)\times(-3)]\times(-2) = (+21)\times(-2) = -42$$

From the above example, we see that the product of three negative integers is negative.

In general, if the negative integers are multiplied even number of times, the product is a positive integer, whereas negative integers are multiplied odd number of times, the product is a negative integer.

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1.4.2 Distributive Property of Multiplication over Addition

We have already studied that multiplication distributes over addition on whole numbers. Let us check the property for integers.

Take for example $(-2)\times(4+5)=[(-2)\times4]+[(-2)\times5]$

LHS		RHS
$=(-2)\times(4+5)$		$=[(-2)\times4]+[(-2)\times5]$
$=(-2)\times9$		$=(-8)+(-10)$
$=(-18)$		$=-8-10$
$=-18$		$=-18$

From the above, we can observe that $(-2)\times(4+5)=[(-2)\times4]+[(-2)\times5]$

Hence, "distributive property of multiplication over addition" is true for integers.

Therefore, for any three integers a, b, c ; $a\times(b+c)=(a\times b)+(a\times c)$

Try these

1. Find the values of the following and check for equality:

   (i) (–6) × (4+(–5)) and ((–6) ×4) + ((–6)×(–5))

   (ii) (–3)×[2+(–8)] and [(–3)×2]+[(–3)×8]

2. Prove the following:

   (i) (–5) × [(–76)+8] = [(–5) ×(–76)] + [(–5)×8]

   (ii) 42 × [7+(–3)] = (42 ×7) + [42×(–3)]

   (iii) (–3) × [(–4)+(–5)] = ((–3) × (–4)) + [(–3)×(–5)]

   (iv) 103 × 25 = (100+3) × 25 = (100×25) +(3×25)

Example 1.20

Prove that (–7) × (+8) is an integer and mention the property.

Solution

(–7) × (+8) = (–56)

Hence, –56 is an integer.

Therefore, (–7) × (+8) is closed under multiplicaton.

Example 1.21

Are (–42) × (–7) and (–7) × (–42) equal? Mention the property.

Solution

Consider, (–42) × (–7),

(–42) × (–7) = +294

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Consider, $(-7) \times (-42)$,

$$(-7) \times (-42) = +294$$

Therefore, $(-42) \times (-7)$ and $(-7) \times (-42)$ are equal.

It is commutative.

Example 1.22

Prove that $[(-2) \times 3] \times(-4) = (-2) \times[3\times(-4)]$.

Solution

In the first case (–2) and (3) are grouped together and in the second case (3) and (–4) are grouped together

L.H.S $= [(-2) \times 3] \times(-4)$ $\quad$ R.H.S $= (-2) \times[3\times(-4)]$

$= (-6) \times (-4) = 24$ $\quad$ $= (-2) \times (-12) = 24$

Therefore, L.H.S. = R.H.S.

$[(-2) \times 3] \times(-4) = (-2) \times[3\times(-4)]$ Hence it is proved.

Example 1.23

Are $(-81) \times [5\times(-2)]$ and $[(-81) \times 5]\times(-2)$ equal? Mention the property.

Solution

Consider, $(-81) \times [5\times(-2)]$,

$$(-81) \times [5\times(-2)] = (-81) \times (-10) = 810$$

Consider, $[(-81) \times 5]\times(-2)$,

$$[(-81) \times 5]\times(-2) = (-405) \times (-2) = 810$$

Therefore, $(-81) \times [5\times(-2)]$ and $[(-81) \times 5]\times(-2)$ are equal.

It is associative.

Example 1.24

Are $3 \times [(-4)+6]$ and $[3 \times(-4)]+(3\times6)$ equal? Mention the property.

Solution

Consider, $3 \times [(-4)+6]$,

$$3 \times [(-4)+6] = 3 \times 2 = 6$$

Consider, $[3 \times(-4)]+[3\times6]$,

$$[3 \times(-4)]+[3\times6] = -12+18 = 6$$

Therefore, $3 \times [(-4)+6]$ and $[3 \times(-4)]+3\times6$ are equal.

It is the distributive property of multiplication over addition.

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Exercise 1.3

1. Fill in the blanks
   (i) $-80\times____ = -80$
   (ii) $(-10)\times____ = 20$
   (iii) $(100)\times____ = -500$
   (iv) $____\times(-9) = -45$
   (v) $____\times 75 = 0$
2. Say true or false
   (i) $(-15)\times 5 = 75$
   (ii) $(-100)\times 0\times 20 = 0$
   (iii) $8 \times (-4) = 32$
3. What will be the sign of the product of the following.
   (i) 16 times of negative integer.
   (ii) 29 times of negative integer.
4. Find the product of
   (i) $(-35)\times 22$ (ii) $(-10)\times 12\times(-9)$ (iii) $(-9)\times(-8)\times(-7)\times(-6)$
   (iv) $(-25)\times 0\times 45\times 90$ (v) $(-2)\times(+50)\times(-25)\times 4$
5. Check the following for equality and if they are equal, mention the property.
   (i) $(8-13)\times 7$ and $8-(13\times 7)$
   (ii) $[(-6)-(+8)]\times(-4)$ and $(-6)-[8\times(-4)]$
   (iii) $3\times[(-4)+(-10)]$ and $[3\times(-4)+3\times(-10)]$
6. During summer, the level of the water in a pond decreases by 2 inches every week due to evaporation. What is the change in the level of the water over a period of 6 weeks?

7. Find all possible pairs of integers that give a product of -50.

Objective type questions

8. Which of the following expressions is equal to –30.
   (i) –20 – (–5 x 2) (ii) (6 x 10) – (6 x 5)
   (iii) (2 x 5) + (4 x 5) (iv) (–6) x (+5)
9. Which property is illustrated by the equation: $(5\times 2)+(5\times 5)=5\times(2+5)$
   (i) commutative (ii) closure
   (iii) distributive (iv) associative

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10. $11\times(-1)=$_____

(i) –1 (ii) 0 (iii) +1 (iv) –11

11. $(-12)\times(-9)=$ _____

(i) 108 (ii) –108 (iii) +1 (iv) –1

1.5 Division of Integers

We have already seen that each multiplication statement has two division statements in whole numbers. Can we try the same for integers also; let us play with this number converter machine and see how division works.

Number Converter

Input	Multiplication Statement	Division Statement	Output
(i) Product of positive integer and positive integer	$8 \times 9 = 72$	$72 \div 9 = 8$, $72 \div 8 = 9$	Positive integer divided by Positive integer is Positive
(ii) Product of positive integer and negative integer	$-10 \times 7 = -70$	$(-70) \div 7 = -10$, $(-70) \div (-10) = 7$	Negative integer divided by Positive integer is Negative Negative integer divided by Negative integer is Positive
(iii) Product of negative integer and negative integer	$(-5)\times(-9) = 45$	$45 \div (-9) = -5$, $45 \div (-5) = -9$	Positive integer divided by Negative integer is Negative

From the above table, we infer that the division of two integers with the same sign is a positive integer.

Division of two integers with opposite signs gives a negative integer.

Try these

(i) $(-32)\div 4=$ _____ (ii) $(-50)\div 50=$ _____ (iii) $30\div 15=$ _____

(iv) $-200\div 10=$ ____ (v) $-48\div 6=$ ____

Example 1.25 Divide: (i) (–85) by 5 (ii) (–250) by (–25) (iii) 120 by (–6) (iv) 182 by (–2)

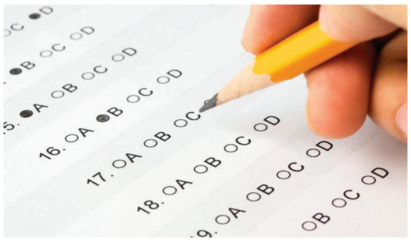
Solution

(i) $(-85)\div 5 = -17$ (ii) $(-250)\div(-25) = +10$

(iii) $120 \div (-6) = -20$ (iv) $182 \div (-2) = -91$

Example 1.26

In a competitive exam 4 marks are given for every correct answer and (-2) marks are given for every incorrect answer, kalaivizhi attended the exam and answered all the questions and scored 20 marks only even though she got 10 correct answers. How many questions did she answer incorrectly?



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Solution

Marks given for one correct answer = 4

Marks given for 10 correct answers = 10×4

= 40

Kalaivizhi's final score = 20

Marks reduced for incorrect answers = 40 − 20

= 20

Therefore, number of questions answered incorrectly = 20 ÷ 2 = 10

Example 1.27

A shopkeeper earns a profit of ₹ 5 by selling one notebook and incurs a loss of ₹ 2 per pen while selling of his old stock. In a particular day he earns neither profit nor loss. If he sold 20 notebooks, how many pens did he sell?

Solution

Since neither profit nor loss

Profit + Loss = 0

(ie) profit = -Loss

Profit earned from 1 notebook = ₹ 5

Profit earned from 20 notebooks = 20 × ₹ 5

= ₹ 100

Loss incurred by selling pens = ₹ 100 Loss

= −100

Loss for 1 pen = ₹ 2

loss = −2

Total number of pens sold $= (-100) \div (-2)$

= 50 pens.

Activity

Students may be divided into two groups and do the activity using "In-out box". This box takes any number as input and apply the rule to the given number and gives the answer. One group will carry out the role of finding output applying the corresponding rule. One is done in each rule for your reference.

Table (I)		Table (II)		Table (III)		Table (IV)	
Rule : Add −7		Rule : Subtract −10		Rule :Multiply by −5		Rule :Divide by −3	
in	out	in	out	in	out	in	out
-10	-17	-20	-10	-7	+35	-18	+6
-7		-13		-12		27	
5		7		+15		-99	
16		10		18		-273	
4		15		−5		-35	

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1.5.1 Properties of Division

Can you find the value when (–5) is divided by 3? The value is not an integer. Clearly, the collection of integers is not 'closed' under division. Test it by taking 5 more examples

To test the commutative property of division on integers, let us take –5 and 3.

$(-5) \div 3 \neq 3 \div (-5)$. Also $5 \div (-3) \neq (-3) \div 5$ and $(-5) \div (-3) \neq (-3) \div (-5)$

Therefore, division of integers are not commutative. Verify this with 5 more examples.

Since the commutative property is not true, associative property does not hold.

Let us take integers, –7 and 1.

$(-7) \div 1 = -7$ but $1 \div (-7) \neq -7$.

Let us take $(-6) \div (-1)$ and $6 \div (-1)$.

$(-6) \div (-1) = 6$ and $6 \div (-1) = -6$.

Therefore, when we divide an integer by –1, we will not get the same integer.

Hence, there does not exist an identity for division of integers.

Take any five integers and verify the above.

Note

An integer divided by zero is not defined. But zero divided by a non-zero integer is zero.

Exercise 1.4

1. Fill in the blanks.
   (i) $(-40) \div ____ = 40$ (ii) $25 \div ____ = -5$
   (iii) $____ \div (-4) = 9$ (iv) $(-62) \div (-62) = ____$
2. Say true or false.
   (i) $(-30) \div (-6) = -6$ (ii) $(-64) \div (-64)$ is 0
3. Find the values of the following.
   (i) $(-75) \div 5$ (ii) $(-100) \div (-20)$
   (iii) $45 \div (-9)$ (iv) $(-82) \div 82$
4. The product of two integers is –135. If one number is –15, Find the other integer.
5. In 8 hours duration, with uniform decrease in temperature, the temperature dropped 24°. How many degrees did the temperature drop each hour?

6. An elevator descends into a mine shaft at the rate of 5 m/min. If the descent starts from 15 m above the ground level, how long will it take to reach –250 m?
7. A person lost 4800 calories in 30 days. If the calory loss is uniform, calculate the loss of calory per day.
8. Given $168 \times 32 = 5376$ then, find $(-5376) \div (-32)$.

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9. How many (-4)'s are there in (-20)?

10. (-400) divided into 10 equal parts gives _____.

Objective type questions

11. Which of the following does not represent an Integer?

   (i) $0 \div (-7)$ (ii) $20 \div (-4)$ (iii) $(-9) \div 3$ (iv) $(12) \div 5$

12. $(-16) \div 4$ is the same as

   (i) $-(-16 \div 4)$ (ii) $-(16) \div (-4)$ (iii) $16 \div (-4)$ (iv) $-4 \div 16$

13. $(-200) \div 10$ is

   (i) 20   (ii) -20 (iii) -190 (iv) 210

14. The set of integers is not closed under

   (i) Addition   (ii) Subtraction   (iii) Multiplication   (iv) Division

DO YOU KNOW?

One of the earliest exposition on negative numbers is by the 7th century Indian Mathematician and Astronomen Brahma gupta, who in his famous text "Brahmasphutasuddhanta" gave a very clear understanding of the concept of zero and consequently the negative integers. His texts were in the form of poetry which when translated reads something like this…

Rule for dealing with positive (fortune) and negative (debt) numbers.

- A debt minus zero is a debt
- A fortune minus zero is a fortune.
- Zero minus zero is a zero.
- A debt subtracted from zero is a fortune.
- A fortune subtracted from zero is a debt.
- The Product of zero by a debt or fortune is zero.
- The Product of zero by zero is zero.
- The Product of quotient of two fortunes is one fortune.
- The Product of quotient of a debt and a fortune is a debt.
- The Product or quotient of a fortune and a debt is a debt.

- The story of mathematics

1.6 Statement Problems on Integers using all Fundamental Operations.

We have learned how to add, subtract, multiply and divide integers. This section will review the rules learned for operations with integers.

All the mathematical problems are life oriented problems.

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Situation 1

If a person's initial balance is ₹ 530 in a particular month. In the same month if he deposits ₹ 230 withdraws ₹ 150, again a withdrawal of ₹ 200 and a deposit of ₹ 99.

How will you find the answer for this?

Situation 2

If a person buys 8 pens for 80 rupees and he sells 4pens with a profit of ₹ 3 per pen and 3 pens with a loss of ₹ 2 per pen and one pen at the buying cost, find the total loss or profit of him.

Do you have any idea to approach this problem?

To solve all the statement problem, the following steps may be followed.

1. Read the problem thoroughly.
2. Write down what is given.
3. Find out what they are asking.
4. Use the required formulae or easy way to attain the answer.
5. Apply it.
6. Solve it.
7. Arrive the answer.
8. Check your answer.

Let us approach the above two situations as given below:

S.No.	Steps	Situation 1	Situation 2
1	Read the problem	If a person's initial balance is ₹ 530 in a particular month. In the same month if he deposits ₹ 230 withdraws ₹ 150, again a withdrawal of ₹ 200 and a deposit of ₹ 99. How will you find the answer for this?	If a person buys 8 pens for 80 rupees and he sells 4pens with a profit of ₹ 3 per pen and 3 pens with a loss of ₹ 2 per pen and one pen at the buying cost, find the total loss or profit of him.
2	Write down what is given	Initial balance = ₹ 530 Deposit 1 = ₹ 230 Deposit 2 = ₹ 99 Withdrawal 1 = ₹ 150 Withdrawal 2 = ₹ 200	Buying 8 pens for ₹ 80 Sells 4 pens at a profit of ₹ 3 per pen. Sells 3 pens at a loss of ₹ 2 per pen. Sells 1 pen at the cost price.
3	What is asked	Final balance	Amount of loss or profit
4	Use formulae	Add and subtract	Find the cost of each pen. Selling price of each pen.

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5.	Apply it	530+230+99 – (150+200)	Cost of each pen = $\frac{80}{8}$ = 10
6.	Solve it	530+230+99 – (150+200) = ₹ 509	Cost of each pen = $\frac{80}{8}$ = 10 S.P. of 4 pens = 13×4 = 52 S.P. of 3 pens = 8×3 = 24 S.P. of 1 pen = 1× 10 = 10 Total S.P. = 52 + 24 + 10 = 86
7.	Arrive the answer	Final balance = ₹ 509	S.P. (86) > C.P. (80) Therefore, profit = ₹ 6

Example 1.28

Ferozkhan collects ₹1150 at the rate of ₹ 25 per head from his classmates on account of the 'Flag Day' in his school and returns ₹ 8 to each one of them, as instructed by his teacher. Find the amount handed over by him to his teacher.

Solution

Ferozkhan collects ₹1150 at the rate of ₹ 25 per head from his classmates on account of the 'Flag Day'

Total amount collected = ₹1150

Amount per head = ₹ 25

Number of students = 1150 ÷ 25 = 46

Amount returned to each student is ₹ 8

Amount returned to 46 students = 46 × 8 = ₹ 368

Amount handed over to the class teacher = ₹ 1150

₹ 368 (–)

₹ 782

$$\begin{array}{r|l} & 46 \\ \hline 25 & 1150 \\ & 100\downarrow \\ \hline & \ \ 150 \\ & \ \ 150 \\ \hline & \ \ \ \ 0 \end{array}$$

Amount handed over to the class teacher = ₹ 782

Example 1.29

Each day, the workers drill down 22 feet further until they hit a pool of water. If the water is at 110 feet, on which day will they hit the pool of water?

Solution

Depth drilled in one day = –22 feet

Depth of water = –110 feet

Number of days required = –110 ÷ –22 = 5

$$\begin{array}{r|l} & 5 \\ \hline 22 & 110 \\ & 110 \\ \hline & \ \ 0 \end{array}$$

Hence the workers wil reach resource in 5 days.

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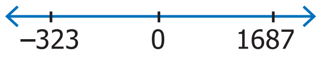
Example 1.30

How many years are between 323 BC(BCE) and 1687 AD(CE)?

Solution

Years in AD(CE) are taken as positive integers and BC(BCE) as negative integers.

Therefore, the difference is



= 1687 – (–323)

= 1687 + 323 = 2010 years

Exercise 1.5

1. One night in Kashmir, the temperature is -5°C. Next day the temperature is 9°C. What is the increase in temperature?

2. An atom can contain protons which have a positive charge $(+)$ and electrons which have a negative charge $(-)$. When an electron and a proton pair up, they become neutral (0) and cancel the charge out. Now, Determine the net charge:

   (i) 5 electrons and 3 protons $\rightarrow$ $-5+3=-2$ that is 2 electrons ⊖ ⊖

   (ii) 6 Protons and 6 electrons $\rightarrow$

   (iii) 9 protons and 12 electrons $\rightarrow$

   (iv) 4 protons and 8 electrons $\rightarrow$

   (v) 7 protons and 6 electrons $\rightarrow$

3. Scientists use the Kelvin Scale (K) as an alternative temperature scale to degrees Celsius (°C) by the relation $T^\circ C = (T+273)$K.

   Convert the following to kelvin:

   (i) -275°C (ii) 45°C (iii) -400°C (iv) -273°C

4. Find the amount that is left in the student's bank account, if he has made the following transaction in a month. His initial balance is ₹ 690.

   (i) Deposit $(+)$ of ₹ 485

   (ii) Withdrawal $(-)$ of ₹ 500

   (iii) Withdrawal $(-)$ of ₹ 350

   (iv) Deposit $(+)$ of ₹ 89

   (v) If another ₹ 300 was withdrawn, what would the balance be?

5. A poet Tamizh Nambi lost 35 pages of his 'lyrics' when his file had got wet in the rain. Use integers, to determine the following:

   (i) If Tamizh Nambi wrote 5 page per day, how many day's work did he lose?

   (ii) If four pages contained 1800 characters, (letters) how many characters were lost?

   (iii) If Tamizh Nambi is paid ₹250 for each page produced, how much money did he lose?

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(iv) If Kavimaan helps Tamizh Nambi and they are able to produce 7 pages per day, how many days will it take to recreate the work lost?

(v) Tamizh Nambi pays kavimaan ₹ 100 per page for his help. How much money does kavimaan receive?

6. Add 2 to me. Then multiply by 5 and subtract 10 and divide now by 4 and I will give you 15! Who am I?

7. Kamatchi, a fruit vendor sells 30 apples and 50 pomegranates. If she makes a profit of ₹ 8 per apple and loss ₹ 5 per pomegranate, what will be her overall profit(or)loss?

8. During a drought, the water level in a dam fell 3 inches per week for 6 consecutive weeks. What was the change in the water level in the dam at the end of this period?

9. Buddha was born in 563 BC(BCE) and died in 483 BC(BCE). Was he alive in 500 BC(BCE)? and find his life time. (Source: Compton's Encylopedia)

Exercise 1.6

Miscellaneous Practice problems

1. What Should be added to -1 to get 10?

2. $-70+20=\square-10$

3. Subtract 94860 from (-86945)

4. Find the value of $(-25)+60+(-95)+(-385)$

5. Find the sum of $(-9999)(-2001)$ and (-5999)

6. Find the product of $(-30)\times(-70)\times15$

7. Divide (-72) by 8

8. Find two pairs of integers whose product is $+15$.

9. Check the following for equality

   (i) $(11+7)+10$ and $11+(7+10)$

   (ii) $(8-13)\times7$ and $8-(13\times7)$

   (iii) $[(-6)-(+8)]\times(-4)$ and $(-6)-[8\times(-4)]$

   (iv) $3\times[(-4)+(-10)]$ and $[3\times(-4)+3\times(-10)]$

10. Kalaivani had ₹ 5000 in her bank account on 01.01.2018. She deposited ₹ 2000 in January and withdrew ₹ 700 in February. What was Kalaivani's bank balance on 01.04.2018, if she deposited ₹ 1000 and withdrew ₹ 500 in March?

11. The price of an item x increases by ₹ 10 every year and an item y decreases by ₹ 15 every year. If in 2018, the price of x is ₹ 50 and y is ₹ 90, then which item will be costlier in the year 2020.

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12. Match the statements in column A and column B

S.No.	A	B
1.	For any two integers 72 and 108, 72+108 is an also an integer.	(a) Distributive property of multiplication over addition.
2.	For any three integers 68, 25 and 99 68 × (25 + 99) = (68 × 25) + (68 × 99)	(b) Multiplicative identity.
3.	0 + (−138) = (−138) = (−138)+0	(c) Commutative property under multiplication.
4.	For any two integers (−5) and 10 (−5) × 10 = 10 ×(−5)	(d) Closed under addition.
5.	1 × (-1098) = (−1098) = (−1098) × 1	(e) Additive identity.

Challenge Problems

13. Say true or false.

(i) The sum of a positive integer and a negative integer is always a positive integer.

(ii) The sum of two integers can never be zero.

(iii) The product of two negative integers is a positive integer.

(iv) The quotient of two integers having opposite sign is a negative integer.

(v) The smallest negative integer is −1.

14. An integer divided by 7 gives a quotient –3. What is that integer?

15. Replace the question mark with suitable integer in the equation

$$72+(-5)-\boxed{?}=72.$$

16. Can you give 5 pairs of single digit integers whose sum is zero?

17. If $P=-15$ and Q = 5 find $(P-Q)\div(P+Q)$

18. If the letters in the English alphabets A to M represent the number from 1 to 13 respectively and N represents 0 and the letters O to Z correspond from −1 to −12, find the sum of integers for the names given below.

For example,

MATH → sum → 13+1–6+8 = 16

(i) YOUR NAME

(ii) SUCCESS

19. From a water tank 100 litres of water is used every day. After 10 days there is 2000 litres of water in the tank. How much water was there in the tank before 10 days?

20. A dog is climbing down in to a well to drink water. In each jump it goes down 4 steps. The water level is in 20th step. How many jumps does the dog take to reach the water level?

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21. Kannan has a fruit shop. He sells 1 dozen banana at a loss of Rs.2 each because it may get rotten next day. What is his loss?

22. A submarine was situated at 650 feet below the sea level. If it descends 200 feet, what is its new position?

23. In a magic square given below each row, column and diagonal should have the same sum, Find the values of x, y and z.

1	–10	x
y	–3	–2
–6	4	z

Summary

- Integers are the collection of natural numbers, zero and negative numbers.
- The number line gives a visual representation of the set of all integers with positive integers to the right of zero and negative integers to the left of zero.
- The sum of the two positive integers is positive and two negative integers is negative.
- The sum of a positive and a negative integer is the difference of the two numbers in value and has the sign of the greater integer.
- The addition of integers has the closure, commutative and associative properties.
- The product of two positive integers and two negative integers are positive.
- The product of two integers with opposite signs is negative.
- The multiplication of integers has the closure, commutative and associative properties.
- The integer 0 is the additive identity for integers.
- The integer 1 is the multiplicative identity for integers.

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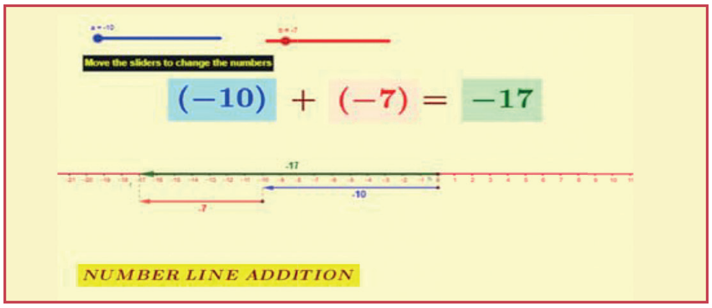
ICT Corner

Expected Result is shown
in this picture



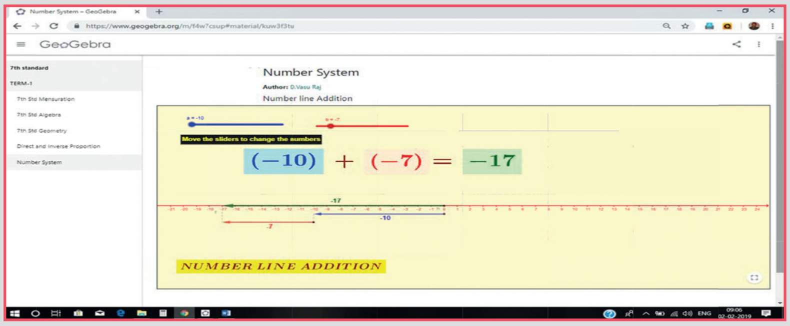
Step – 1 :

Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work book named "Number System" will open. Select Term-1.

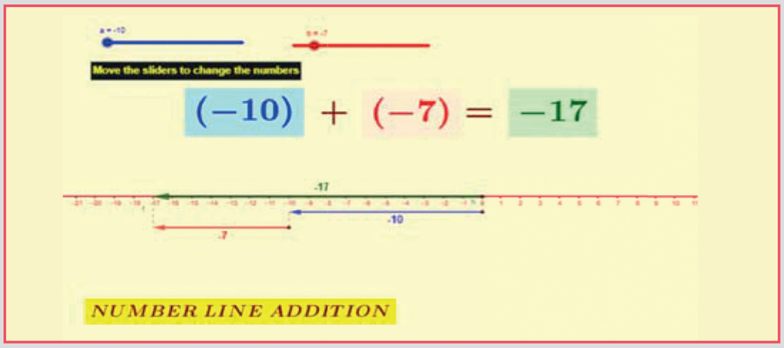
Step - 2 :

There are several work sheets for each chapter. Soelect the worksheet "Number System". In this Number line addition is given. Move the sliders to change the numbers. You can see the answer in green colour arrow.

Step 1



Step 2



Browse in the link

Number system : https://ggbm.at/f4w7csup
or Scan the QR Code.

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Chapter

2

MEASUREMENTS

QFKLJ

Learning Objectives

- To recall the concepts of perimeter and area of square, rectangle, right angled triangle and combined shapes.
- To understand and find the area and perimeter of parallelogram, rhombus and trapezium.

Recap

In ancient days people used non-standardised measures such as cubit, king's foot, king's arm and yard etc. Later, people realised the need for standardised units and International System of Units which were introduced in the year 1971.

The SI Units of various measures are shown in the table

Distance	weight	Time
metre	gram	second

In Class VI, we studied about area and perimeter of rectangle, square and right angled triangle.

Perimeter is the distance around and Area is the region occupied by the closed shape.

Try these

Find the missing values for the following:

S.No.	Length	Breadth	Area	Perimeter
(i)	12 m	8 m		
(ii)	15 cm		90 $sq.cm$	
(iii)		50 mm		300 mm
(iv)	12 cm			44 cm

Hint:
The perimeter of a rectangle $= 2\times(l + b)$ units.
Area of a rectangle$= l \times b$ square units.
(l and b are length and breadth of a rectangle).

S.No.	Side	Area	Perimeter
(i)	60 cm		
(ii)		64 $sq.m$	
(iii)			100 mm

Hint:
Perimeter of a square $= 4 \times a$ units.
Area of a square $= a \times a$ square units.
('a' is the side of the square)

S.No.	base	height	Area
(i)	13 m	5 m	
(ii)	16 cm		240 $sq.cm$
(iii)		6 mm	84 $sq.mm$

Hint:
Area of the right angled triangle $= \frac{1}{2}(b\times h)$ square units
('b' is the base and 'h' is the height of the triangle)

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2.1 Introduction

We have studied area of four sided shapes such as square and rectangle. Do you think that all the four sided shapes will happen to be square or rectangle? Think!

Let us learn about some more four sided shapes that we see around us through the conversation that follows.

Observe the shapes found in the figure

Teacher : Can you tell me the name of the shapes that you see in the figure?

Student : Yes teacher, there is a triangle, square and rectangle

Teacher : What is the shape, numbered 4 in the figure?

Student : The shape looks like a rectangle because the opposite sides are equal and parallel but the adjacent sides do not make right angle. Can we call such shapes as rectangles?

Teacher : Even though the opposite sides are equal and parallel, the adjacent sides do not make right angles instead they make acute and obtuse angles. This shape has a special name called parallelogram.

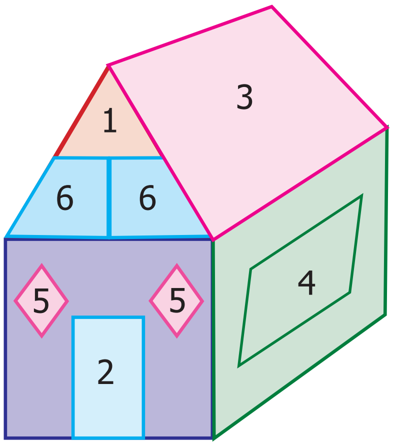

Fig.2.1

Student : Teacher, can you tell me about shape, numbered 5?

Teacher : Try to tell the properties that you know, then I will help you.

Student : Shape 5 has all the sides equal and looks like a square but the adjacent sides do not make right angles. Is there any special name for such shapes.

Teacher : Yes, it has a special name called rhombus. What about the shape, numbered 6?

Student : Shape 6 does not have any of the properties of square and rectangle. But one pair of opposite sides are parallel. Does this also have a different name?

Teacher : Yes, it is called trapezium.

Now, let us learn about all the three new shapes namely parallelogram, rhombus and trapezium.

2.2 Parallelogram

Ask any four students to come with a rope to form a rectangle ABCD as shown in Fig 2.2(i). Students standing at C and D are asked to move 4 equal steps to their left to form the shape as shown in Fig. 2.2(ii). Now, the new shape formed is called parallelogram. The pair of sides AB and CD are parallel to each other and the other pair of sides BC and AD are also parallel to each other. The length of the parallel sides are found to be equal.

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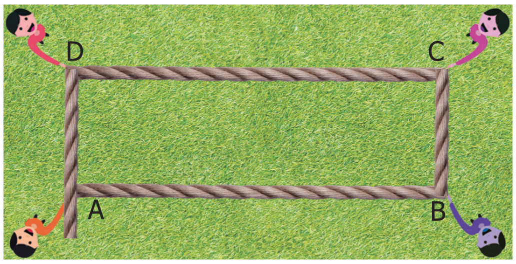

Fig.2.2(i)

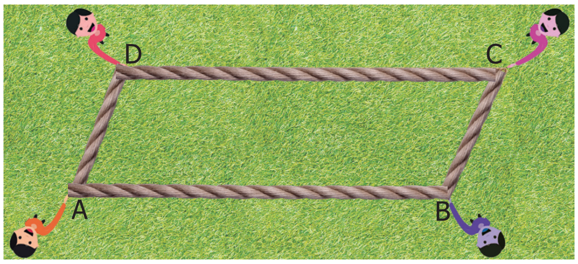

Fig.2.2(ii)

Hence, we can conclude that a parallelogram is a four sided closed shape, in which opposite sides are both parallel and equal.

MATHEMATICS ALIVE - MEASUREMENTS IN REAL LIFE

Wall tiles

Sweet

Window

2.2.1 Area and Perimeter of the Parallelogram

Draw a parallelogram on a graph sheet as shown in Fig.2.3(i) and cut it. Draw a perpendicular line from one vertex to the opposite side. Cut the triangle and shift the triangle to the other side of the parallelogram as shown in Fig.2.3(ii). What shape is seen now? It is a rectangle as in Fig.2.3(iii). Hence, the area of the parallelogram is the same as that of the rectangle.

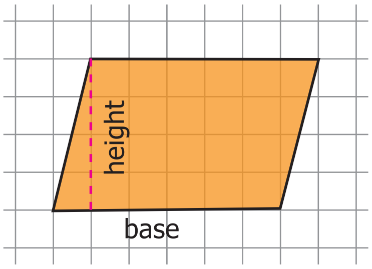

Fig.2.3(i)

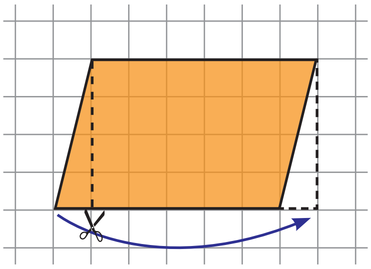

Fig.2.3(ii)

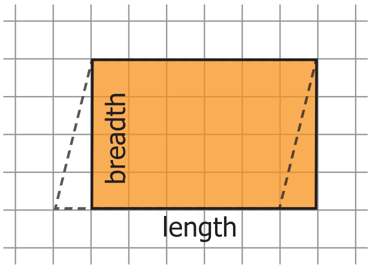

Fig.2.3(iii)

Therefore, area of the rectangle = length x breadth

= base x height $sq.units$.

= b x h $sq.units$.

= Area of the parallelogram.

Further, the perimeter of a parallelogram is the sum of the lengths of the four sides.

Think

1. Explain the area of the parallelogram as sum of the areas of the two triangles.
2. A rectangle is a parallelogram but a parallelogram is not a rectangle. Why?

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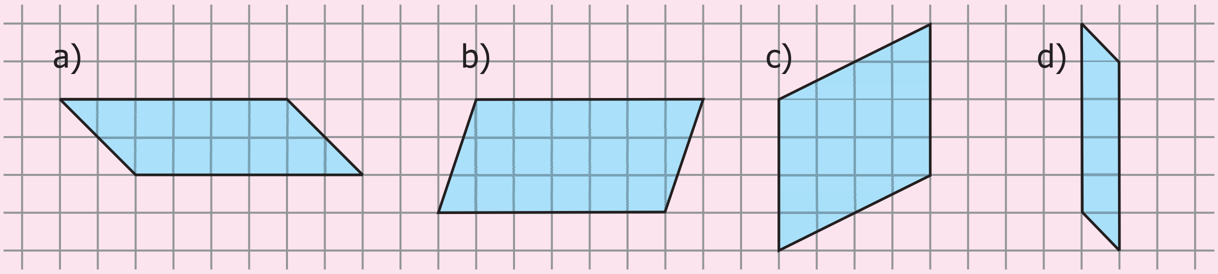
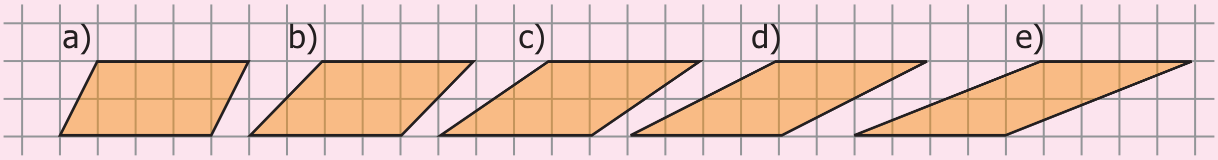
Try these

1. Count the squares and find the area of the following parallelograms by converting those into rectangles of the same area (without changing the base and height).

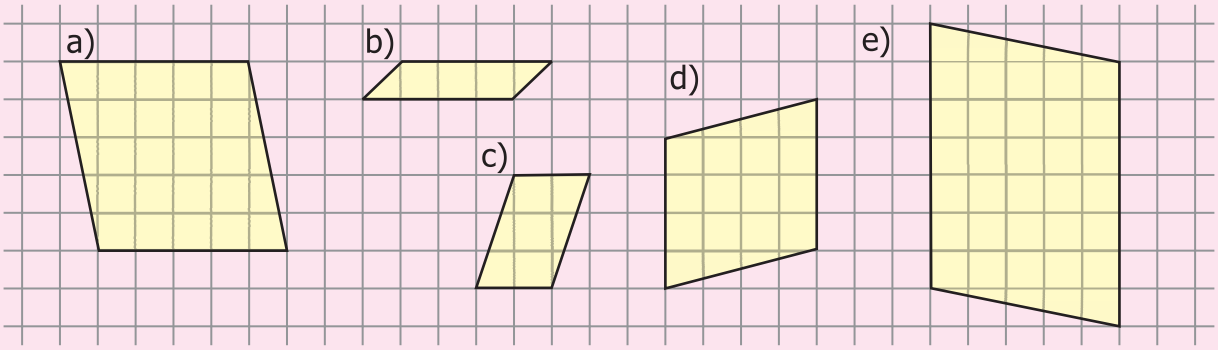


a.________ sq.units b.________ sq.units c.________ sq.units d.________ sq.units

2. Draw the heights for the given parallelograms and mark the measure of their bases and find the area. Analyse your result.



3. Find the area of the following parallelograms by measuring their base and height, using formula.



a.____ sq. units b.____ sq. units c.____ sq. units d.____ sq. units e.____ sq. units

4. Draw as many parallelograms as possible in a grid sheet with the area 20 square units each.

Example 2.1 Find the area and perimeter of the parallelogram given in the figures.

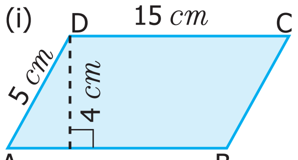


Fig.2.4

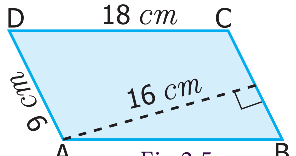


Fig.2.5

Solution

(i) From the Fig.2.4

Base of a parallelogram (b) = 15 cm, Height of a parallelogram (h) = 4 cm

Area of a parallelogram = b x h $sq.units$. Therefore, Area = 15 × 4 = 60 $sq.\ cm.$

Thus, area of the parallelogram is 60 $sq.\ cm.$

Perimeter of the parallelogram = sum of the length of the four sides.

= (15+5+15+5) = 40 $cm.$

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(ii) From the Fig.2.5

Base of a parallelogram (b) = 9 cm, Height of a parallelogram (h) = 16 cm.

Area of a parallelogram = $b \times h$ $sq.units$ Therefore, Area = 9×16 = 144 $sq.\ cm$

Thus, area of the parallelogram is 144 $sq.\ cm$.

Perimeter of the parallelogram = sum of the length of the four sides.

= (18+9+18+9) = 54 cm.

Example 2.2 One of the sides and the corresponding height of the parallelogram are 12 m and 8 m respectively. Find the area of the parallelogram.

Solution

Given: b = 12 m, h = 8 m

Area of the parallelogram = $b \times h$ $sq.units$

= 12 × 8 = 96 $sq.m$

Therefore, Area of the parallelogram = 96 $sq.m$.

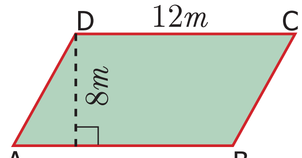

Fig.2.6

Example 2.3

Find the height 'h' of the parallelogram whose area and base are 368 $sq.\ cm$ and 23 cm respectively.

Solution

Given: Area = 368 $sq.\ cm$, base b = 23 cm

Area of the parallelogram = 368 $sq.\ cm$

$b \times h$ = 368

23 × h = 368

$$h = \frac{368}{23} = 16\ cm$$

Thus, the height of the parallelogram = 16 cm.

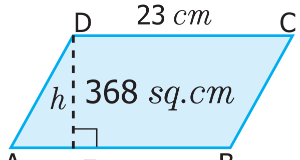

Fig.2.7

Example 2.4

A parallelogram has adjacent sides 12 cm and 9 cm. If the distance between its shorter sides is 8 cm, find the distance between its longer side.

Solution

Given that the adjacent sides of parallelogram are 12 cm and 9 cm

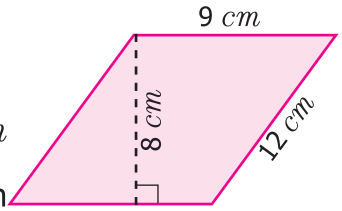

Fig.2.8

If we choose the shorter side as base, that is b = 9 cm then distance between the shorter sides is height, that is h = 8 cm

Area of parallelogram = $b \times h$ $sq.units$ = 9 × 8 = 72 $sq.\ cm$.

Again, if we choose longer side as base, that is b = 12 cm then distance between longer sides is height. Let it be 'h' units.

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We know that, the area of the parellelogram = 72 $sq.cm$

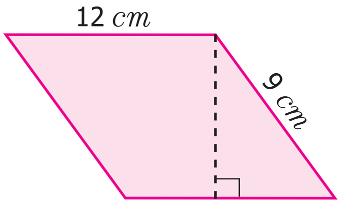


Fig.2.9

$$b \times h = 72$$

$$12 \times h = 72$$

$$h = \frac{72}{12} = 6 \; cm$$

Therefore, the distance between the longer sides = 6 cm.

Example 2.5

The base of the parallelogram is thrice its height. If the area is 192 $sq.\ cm$, find the base and height.

Solution

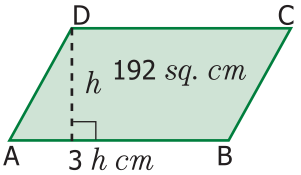


Fig.2.10

Let the height of the parallelogram = $h\ cm$

Then the base of the parallelogram = $3h\ cm$

Area of the parallelogram = 192 $sq.\ cm$

$$b \times h = 192$$

$$3h \times h = 192$$

$$3h^2 = 192$$

$$h^2 = 64$$

$$h \times h = 8 \times 8$$

$$h = 8 \; cm$$

$$\text{base} = 3h = 3 \times 8 = 24 \; cm$$

Therefore, base of the parallelogram is 24 cm and height is 8 cm.

DO YOU KNOW?

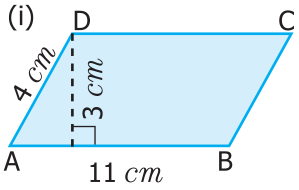
Most of the bridges are constructed using parallelogram as the structural design (For example, Pamban Bridge in Rameswaram)

Engineers use properties of parallelograms to build and repair bridges.

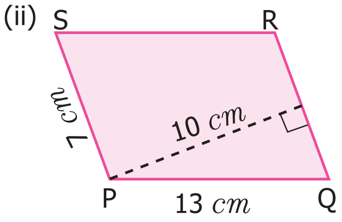
Exercise 2.1

1. Find the area and perimeter of the following parallelograms:

(i)



(ii)



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2. Find the missing values.

S.No.	Base	Height	area
(i)	18 cm	5 cm	
(ii)	8 m		56 $sq.m$
(iii)		17 mm	221 $sq.mm$

3. Suresh won a parallelogram-shaped trophy in a state level Chess tournament. He knows that the area of the trophy is 735 $sq.\ cm$ and its base is 21 cm. What is the height of that trophy?

4. Janaki has a piece of fabric in the shape of a parallelogram. Its height is 12 m and its base is 18 m. She cuts the fabric into four equal parallelograms by cutting the parallel sides through its mid-points. Find the area of each new parallelogram.

5. A ground is in the shape of parallelogram. The height of the parallelogram is 14 metres and the corresponding base is 8 metres longer than its height. Find the cost of levelling the ground at the rate of ₹ 15 per $sq.\ m$.

Objective type questions

6. The perimeter of a parallelogram whose adjacent sides are 6 cm and 5 cm is

   (i) 12 cm (ii) 10 cm (iii) 24 cm (iv) 22 cm

7. The area of a parallelogram whose base 10 m and height 7 m is

   (i) 70 $sq.\ m$ (ii) 35 $sq.\ m$ (iii) 7 $sq.\ m$ (iv) 10 $sq.\ m$

8. The base of the parallelogram with area is 52 $sq.\ cm$ and height 4 cm is

   (i) 48 cm (ii) 104 cm (iii) 13 cm (iv) 26 cm

9. What happens to the area of the parallelogram, if the base is increased 2 times and the height is halved?

   (i) Decreases to half (ii) Remains the same

   (iii) Increases by two times (iv) none

10. In a parallelogram the base is three times its height. If the height is 8 cm then the area is

   (i) 64 $sq.\ cm$ (ii) 192 $sq.\ cm$ (iii) 32 $sq.\ cm$ (iv) 72 $sq.\ cm$

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2.3 Rhombus

Take four sticks of equal length and four connectors. Connect four sticks to form a square as shown in the Fig.2.11(i). Then, try to make any two opposite vertices closer as shown in the Fig.2.11(ii) such that opposite sides remain parallel to each other to get a new shape called rhombus.

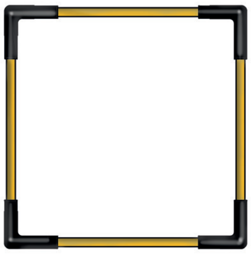

Fig.2.11(i)

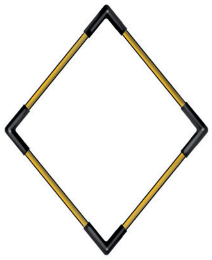

Fig.2.11(ii)

Hence, we conclude that, in a parallelogram, if all the sides are equal then it is called a rhombus.

Note

In a rhombus, (i) all the sides are equal (ii) opposite sides are parallel (iii) diagonals divide the rhombus into 4 right angled triangles of equal area. (iv) the diagonals bisect each other at right angles.

2.3.1 Area of the rhombus if base and height are given

Draw a rhombus on a graph sheet as shown in the Fig.2.12(i) and cut it. Draw a perpendicular line from one vertex to the opposite side. Cut the triangle and shift the triangle to the other side of the rhombus as shown in the Fig.2.12(ii).What shape do you see? It is a rectangle. Hence, the area of the rhombus is the same as that of the rectangle.

Area of the rectangle

= length × breadth *sq.units*

= base × height *sq.units*

= area of the rhombus

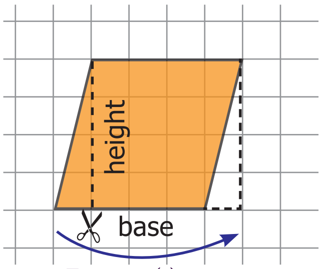

Fig.2.12(i)

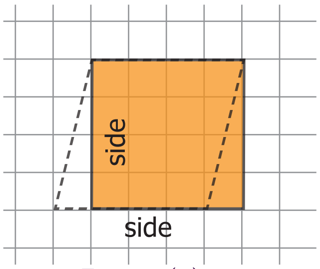

Fig.2.12(ii)

2.3.2 Area of the rhombus if the diagonals are given

Let us find, area of the rhombus ABCD by splitting it into two triangles.

Here AB = BC = CD = DA and diagonals AC (d_1) and BD (d_2) are perpendicular to each other.

Area of the rhombus ABCD = Area of triangle ABC + Area of triangle ADC

$$= \frac{1}{2} \times AC \times OB + \frac{1}{2} \times AC \times OD$$

$$= \frac{1}{2} \times AC\ (OB+OD)$$

$$= \frac{1}{2} \times AC \times BD$$

$$= \frac{1}{2} \times d_1 \times d_2 \ sq.\ units$$

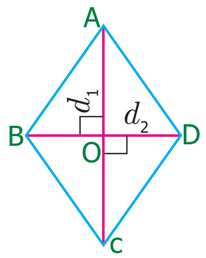

Fig.2.13

Therefore, area of the rhombus = $\frac{1}{2}$ (product of diagonals) *square units.*

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Try these

1. Observe the Fig. 2.14 and answer the following questions.

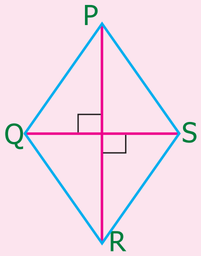

Fig.2.14

(i) Name two pairs of opposite sides.

(ii) Name two pairs of adjacent sides.

(iii) Name the two diagonals

2. Find the area of the rhombus given in Fig. 2.15 and Fig. 2.16

(i)

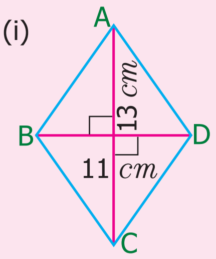

Fig.2.15

(ii)

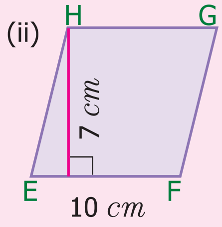

Fig.2.16

Example 2.6

Find the area of the rhombus whose side is 17 cm and the height is 8 cm.

Solution

Given:

Base = 17 cm, height = 8 cm

Area of the rhombus = b x h $sq.\ units$

= 17 x 8 = 136

Therefore, area of the rhombus = 136 $sq.\ cm.$

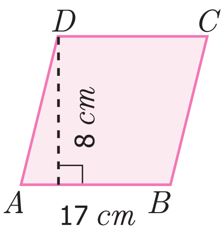

Fig.2.17

Think

1. Can you find the perimeter of the rhombus?
2. Can diagonals of a rhombus be of the same length?
3. A square is a rhombus but a rhombus is not a square. Why?
4. Can you draw a rhombus in such a way that the side is equal to the diagonal.

Example 2.7

Calculate the area of the rhombus having diagonals equal to 6 m and 8 m.

Solution

Given: $d_1 = 6\ m,\ d_2 = 8\ m$

Area of the rhombus $= \frac{1}{2} \times (d_1 \times d_2)\ sq.\ units$

$= \frac{1}{2} \times (6 \times 8)$

$= \frac{48}{2}$

$= 24\ sq.m$

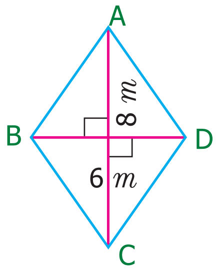

Fig.2.18

Hence, area of the rhombus is 24 $sq.m.$

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Example 2.8

If the area of the rhombus is 60 $sq.\ cm$ and one of the diagonals is 8 cm, find the length of the other diagonal.

Solution

Given, the length of one diagonal (d_1) = 8 cm

Let, the length of the other diagonal be $d_2\ cm$

$$\text{Area of the rhombus} = 60\ sq.\ cm \text{ (given)}$$

$$\frac{1}{2} \times (d_1 \times d_2) = 60$$

$$\frac{1}{2} \times (8 \times d_2) = 60$$

$$8 \times d_2 = 60 \times 2$$

$$d_2 = \frac{120}{8}$$

$$= 15$$

Therefore, length of the other diagonal is 15 cm.

Example 2.9

The floor of an office building consists of 200 rhombus shaped tiles and each of its length of the diagonals are 40 cm and 25 cm. Find the total cost of polishing the floor at ₹ 45 per $sq.m$.

Solution

Given, the length of the diagonals of a rhombus shaped tile are 40 cm and 25 cm

$$\text{The area of one tile} = \frac{1}{2} \times (d_1 \times d_2)\ sq.\ units$$

$$= \frac{1}{2} \times 40 \times 25$$

$$= 500\ sq.\ cm$$

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$$\text{Therefore, the area of 200 such tiles} = 200 \times 500$$

$$= 100000\ sq.\ cm$$

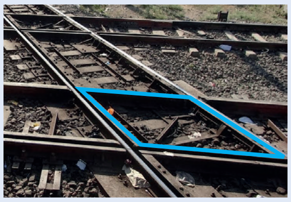
$$= \frac{100000}{10000}\ (1\ sq.\ m = 10000\ sq.\ cm)$$

$$= 10\ sq.\ m$$

Therefore, the cost of polishing 200 such tiles at the rate of ₹ 45 per $sq.\ m$

= 10 x 45 = ₹ 450.

DO YOU KNOW?



In the terminology of railways, "Diamond Crossing" refers to the point where two railway lines cross, forming the shape of rhombus at the crossing point. The most famous diamond crossing is at Nagpur, where lines from the North, South, East, and Western railways meet.

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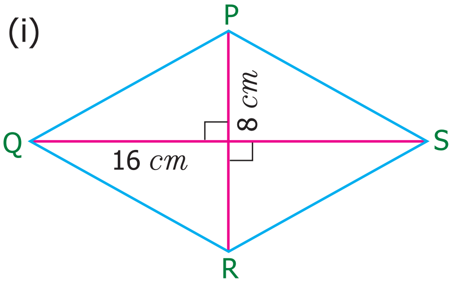
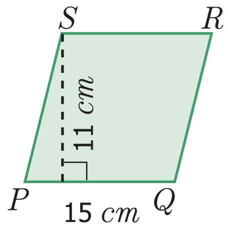
Exercise 2.2

1. Find the area of rhombus PQRS shown in the following figures.

(i)



(ii)



2. Find the area of a rhombus whose base is 14 cm and height is 9 cm.

3. Find the missing value.

S.No.	Diagonal (d_1)	Diagonal (d_2)	Area
(i)	19 cm	16 cm	
(ii)	26 m		468 $sq.\ m$
(iii)		12 mm	180 $sq.\ mm$

4. The area of a rhombus is 100 $sq.\ cm$ and length of one of its diagonals is 8 cm. Find the length of the other diagonal.

5. A sweet is in the shape of rhombus whose diagonals are given as 4 cm and 5 cm. The surface of the sweet should be covered by an aluminum foil. Find the cost of aluminum foil used for 400 such sweets at the rate of ₹ 7 per 100 $sq.\ cm$.

Objective type questions

6. The area of the rhombus with side 4 cm and height 3 cm is

(i) 7 $sq.\ cm$ (ii) 24 $sq.\ cm$ (iii) 12 $sq.\ cm$ (iv) 10 $sq.\ cm$

7. The area of the rhombus when both diagonals measuring 8 cm is

(i) 64 $sq.\ cm$ (ii) 32 $sq.\ cm$ (iii) 30 $sq.\ cm$ (iv) 16 $sq.\ cm$

8. The area of the rhombus is 128 $sq.\ cm$ and the length of one diagonal is 32 cm. The length of the other diagonal is

(i) 12 cm (ii) 8 cm (iii) 4 cm (iv) 20 cm

9. The height of the rhombus whose area 96 $sq.\ m$ and side 24 m is

(i) 8 m (ii) 10 m (iii) 2 m (iv) 4 m

10. The angle between the diagonals of a rhombus is

(i) 120º (ii) 180º (iii) 90º (iv) 100º

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2.4 Trapezium

We are familiar with parallelogram and rhombus. What will happen in a parallelogram if one pair of parallel sides are not equal? Can you draw it? How will it look like? The shape looks as given in Fig.2.19.

A parallelogram with one pair of non-parallel sides is known as a Trapezium.

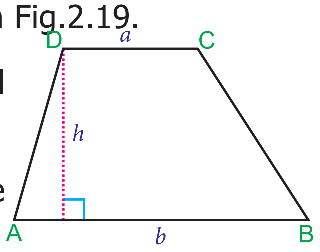

Fig.2.19

The distance between the parallel sides is the height of the trapezium.

Here the sides AD and BC are not parallel, but AB is parallel to DC.

Isosceles Trapezium

If the non - parallel sides of a trapezium are equal (AD = BC) then, it is known as an isosceles trapezium.

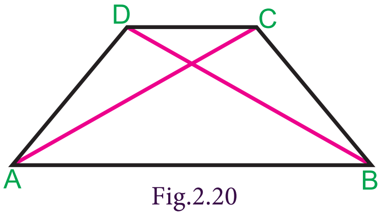

Fig.2.20

2.4.1 Area of the Trapezium

ABCD is a trapezium with parallel sides AB and DC measuring 'a'units and 'b' units respectively. Let the distance between the two parallel sides be 'h' units. The diagonal BD divides the trapezium into two triangles ABD and BCD.

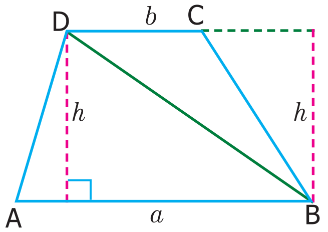

Fig.2.21

Area of the trapezium = area $\triangle$ of ABD + area of $\triangle$ BCD

$= \frac{1}{2} \times AB \times h + \frac{1}{2} \times DC \times h$ [since the two triangles ABD and BCD have same heights]

Area of a trapezium $= \frac{1}{2} \times \{h \times (AB + DC)\}$

Therefore, Area of the trapezium $= \frac{1}{2} \times h\ (a+b)\ sq.units.$

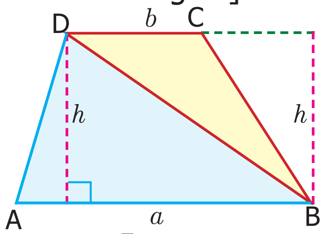

Fig.2.22

Example 2.10

Find the area of the trapezium whose height is 14 cm and the parallel sides are 18 cm and 9 cm of length.

Solution

Given, height (h) = 14 cm

parallel sides are (a) = 18 cm and (b) = 9 cm

Area of the trapezium $= \frac{1}{2} \times h\ (a+b)$

$= \frac{1}{2} \times 14\ (18+9)$

$= 7(27)$

$= 189\ sq.\ cm$

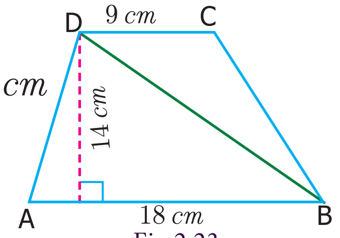

Fig.2.23

Therefore, area of the trapezium is 189 $sq.\ cm.$

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Example 2.11

The parallel sides of a trapezium are 23 cm and 12 cm. The distance between the parallel sides is 9 cm. Find the area of the trapezium.

Solution

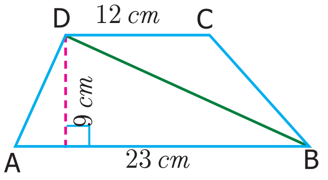

Fig.2.24

Given, height (h) = 9 cm

Parallel sides are (a) = 23 cm and (b) = 12 cm

Area of the trapezium = $\frac{1}{2} \times h\,(a+b)$

= $\frac{1}{2} \times 9\,(23+12)$

= $\frac{1}{2} \times 9\,(35)$

= 157.5 $sq.\ cm$

Therefore, Area of the trapezium is 157.5 $sq.\ cm$.

Example 2.12

The area of a trapezium is 828 $sq.\ cm$. If the lengths of its parallel sides are 19.6 cm and 16.4 cm, find the distance between them.

Solution

Given, Area of the Trapezium= 828 cm^2

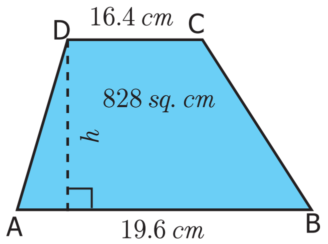

Fig.2.25

$\frac{1}{2} \times h\,(a+b)$ = 828

$\frac{1}{2} \times h\,(19.6+16.4)$ = 828

$\frac{1}{2} \times h\,(36)$ = 828

$h\,(18)$ = 828

$h = \frac{828}{18}$

h = 46 cm

Therefore, distance between the parallel sides = 46 cm

Example 2.13

The area of a trapezium is 352 $sq.\ cm$ and the distance between its parallel sides is 16 cm. If one of the parallel sides is of length 25 cm then find the length of the other side.

Solution

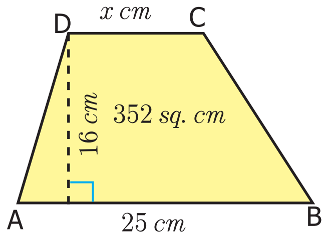

Fig.2.26

Let, the length of the required side be 'x' cm.

Then, area of the trapezium = $\frac{1}{2} \times h\,(a+b)$ $sq.\ units$

= $\frac{1}{2} \times 16\,(25+x)$

$$= 200+8x$$

But, the area of the trapezium $= 352\ sq.\ cm$ (given)

Therefore, $200 + 8x = 352$

$$\Rightarrow 8x = 352 - 200$$

$$\Rightarrow 8x = 152$$

$$\Rightarrow x = \frac{152}{8}$$

$$\Rightarrow x = 19$$

Therefore, the length of the other side is 19 cm.

Think

1. Can you find the perimeter of the trapezium? Discuss.
2. Mention any three life situations where the isosceles trapeziums are used.

Example 2.14

The collar of a shirt is in the form of isosceles trapezium whose parallel sides are 17 cm and 14 cm and the distance between them is 4 cm. Find the area of canvas that will be used to stitch the collar.

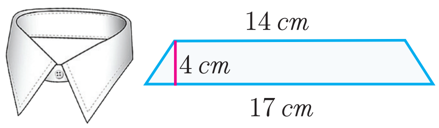

Fig.2.27

Solution

Given height $(h) = 4\ cm$

Parallel sides are $(a) = 17\ cm$ and $(b) = 14\ cm$

Area of the trapezium $= \frac{1}{2} \times h\ (a+b)\ sq.\ units$

$$= \frac{1}{2} \times 4\ (17+14)$$

$$= \frac{1}{2} \times 4\ (31)$$

$$= 62\ sq.\ cm$$

Therefore, the area of canvas used is 62 $sq.\ cm$.

DO YOU KNOW?

Though there are various common types of cross sections available for irrigation canals, trapezoidal cross section is widely used, because it prevents overflowing during heavy rains, maximum water flow is possible with minimum time (least frictional resistance) and safety measures can be taken easily while someone or something falls into it.

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Exercise 2.3

1. Find the missing values.

S.No.	Height 'h'	Parallel side 'a'	Parallel side 'b'	Area
(i)	10 m	12 m	20 m	
(ii)		13 cm	28 cm	492 $sq.\ cm$
(iii)	19 m		16 m	323 $sq.\ m$
(iv)	16 cm	15 cm		360 $sq.\ cm$

2. Find the area of a trapezium whose parallel sides are 24 cm and 20 cm and the distance between them is 15 cm.

3. The area of a trapezium is 1586 $sq.\ cm$. The distance between its parallel sides is 26 cm. If one of the parallel sides is 84 cm then, find the other side.

4. The area of a trapezium is 1080 $sq.\ cm$. If the lengths of its parallel sides are 55.6 cm and 34.4 cm, find the distance between them.

5. The area of a trapezium is 180 $sq.\ cm$ and its height is 9 cm. If one of the parallel sides is longer than the other by 6 cm, find the length of the parallel sides.

6. The sunshade of a window is in the form of isosceles trapezium whose parallel sides are 81 cm and 64 cm and the distance between them is 6 cm. Find the cost of painting the surface at the rate of ₹ 2 per $sq.\ cm$.

7. A window is in the form of trapezium whose parallel sides are 105 cm and 50 cm respectively and the distance between the parallel sides is 60 cm. Find the cost of the glass used to cover the window at the rate of ₹ 15 per 100 $sq.\ cm$.

Objective type questions

8. The area of the trapezium, if the parallel sides are measuring 8 cm and 10 cm and the height 5 cm is

(i) 45 $sq.\ cm$ (ii) 40 $sq.\ cm$ (iii) 18 $sq.\ cm$ (iv) 50 $sq.\ cm$

9. In a trapezium if the sum of the parallel sides is 10 cm and the area is 140 $sq.\ cm$, then the height is

(i) 7cm (ii) 40 cm (iii) 14 cm (iv) 28 cm

10. when the non-parallel sides of a trapezium are equal then it is known as

(i) a square (ii) a rectangle

(iii) an isosceles trapezium (iv) a parallelogram

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Exercise 2.4

Miscellaneous Practice problems

1. The base of the parallelogram is 16 cm and the height is 7 cm less than its base. Find the area of the parallelogram.

2. An agricultural field is in the form of a parallelogram, whose area is 68.75 $sq.\ hm$. The distance between the parallel sides is 6.25 hm. Find the length of the base.

3. A square and a parallelogram have the same area. If the side of the square is 48 m and the height of the parallelogram is 18 m, find the length of the base of the parallelogram.

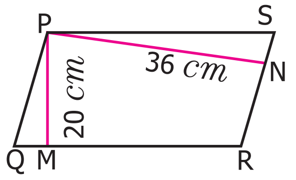
4. The height of the parallelogram is one fourth of its base. If the area of the parallelogram is 676 $sq.\ cm$, find the height and the base.

5. The area of the rhombus is 576 $sq.\ cm$ and the length of one of its diagonal is half of the length of the other diagonal then find the length of the diagonals.

6. A ground is in the form of isosceles trapezium with parallel sides measuring 42 m and 36 m long. The distance between the parallel sides is 30 m. Find the cost of levelling it at the rate of ₹ 135 per $sq.m$.

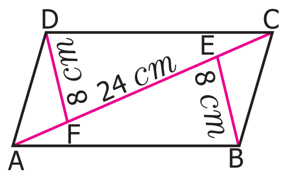
Challenge Problems

7. In a parallelogram PQRS (see the diagram) PM and PN are the heights corresponding to the sides QR and RS respectively. If the area of the parallelogram is 900 $sq.\ cm$ and the length of PM and PN are 20 cm and 36 cm respectively, find the length of the sides QR and SR.

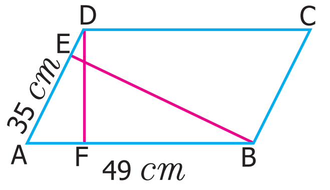


8. If the base and height of a parallelogram are in the ratio 7:3 and the height is 45 cm then, find the area of the parallelogram.

9. Find the area of the parallelogram ABCD, if AC is 24 cm and BE = DF= 8 cm.



10. The area of the parallelogram ABCD is 1470 $sq\ cm$. If AB = 49 cm and AD = 35 cm then, find the heights DF and BE.



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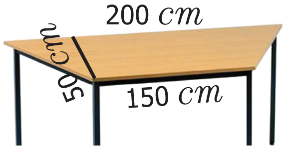
11. One of the diagonals of a rhombus is thrice as the other. If the sum of the length of the diagonals is 24 cm, then find the area of the rhombus.

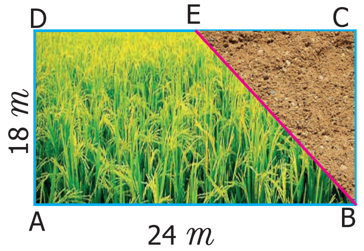
12. A man has to build a rhombus shaped swimming pool. One of the diagonal is 13 m and the other is twice the first one. Then find the area of the swimming pool and also find the cost of cementing the floor at the rate of ₹ 15 per $sq.cm$.

13. Find the height of the parallelogram whose base is four times the height and whose area is 576 $sq.\ cm$.

14. The table top is in the shape of trapezium with measurements given in the figure. Find the cost of the glass used to cover the table at the rate of ₹ 6 per 10 $sq.\ cm$.



15. Arivu has a land ABCD with the measurements given in the figure. If a portion ABED is used for cultivation (where E is the mid-point of DC), find the cultivated area.



Summary

- Parallelogram is a four sided closed shape in which opposite sides are both parallel and equal.
- Area of the Parallelogram = $b \times h$ $sq.\ units$, where b = base ; h = height.
- In a parallelogram if all the sides are equal then it is called Rhombus.
- Area of rhombus = $\frac{1}{2} \times d_1 \times d_2$ $sq.\ units$, where d_1, d_2 are the diagonals.
- A parallelogram with one pair of non-parallel sides is known as a Trapezium.
- Area of the Trapezium = $\frac{1}{2} \times h\ (a+b)$ $sq.\ units$. Let the distance between the two parallel sides be 'h' units.
- If the non - parallel sides of a Trapezium are equal then it is known as an isosceles Trapezium.

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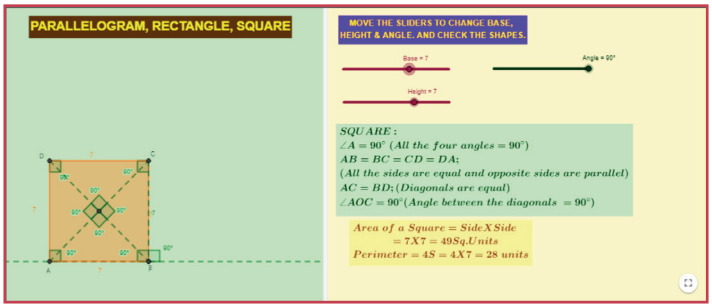
ICT Corner

Expected Result is shown in this picture



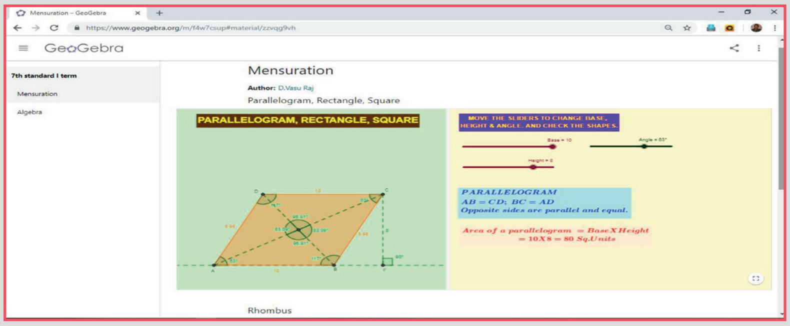
Step – 1 :

Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named “7th std Mensuration” will open. In the right side of the work sheet there are three sliders to change Length, Breadth and Corner angle.

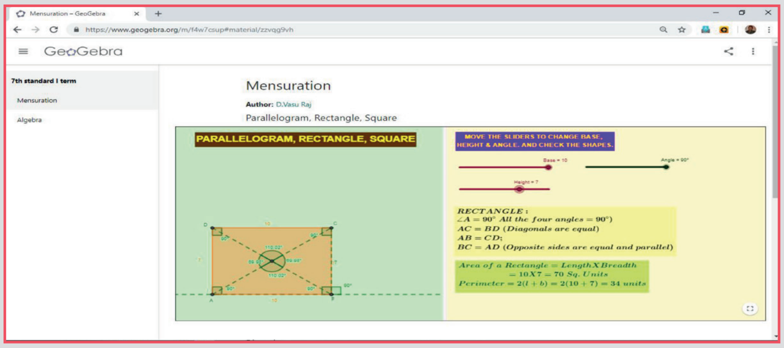
Step - 2 :

Move the sliders to get, Parallelogram or Rectangle or Square and see the points given and observe.

Step 1



Step 2



Browse in the link

Mensuration: https://ggbm.at/zzvqg9vh
or Scan the QR Code.

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Chapter

3 ALGEBRA

$29 + 3x + 5y$

$8ab + 4ab + 2ab$

Learning objectives

- To identify variables and constants in the given terms of an algebraic expression.
- To find the coefficients of the terms of an algebraic expression.
- To identify like and unlike terms.
- To add and subtract algebraic expressions with integer co-efficients.
- To form simple expressions in two variables.
- To understand simple linear equations and solve problems.

Recap

In class VI, we have learnt how geometric patterns and number patterns can be generalised using variables and constants. A variable takes different values which is represented by x, y, z... and constant has numerical values such as 31, -7, $\frac{3}{10}$ etc.

For example,

(i) The number of Ice – candy sticks required to form one square (□) is four sticks, for two squares is eight sticks, for three squares is twelve sticks and so on.

Continuing in the same way, it is clear that if the number of squares (□) to be formed is k (any natural number), then the number of candy sticks required will be $4 \times k = 4k$, where k is a variable and 4 is a constant.

This can be observed in the following table:

Number of □ formed	1	2	3	...	k	...
Number of Ice candy sticks used / required	4×1	4×2	4×3	...	$4 \times k$	...
	4	8	12	...	$4k$	...

(ii) Observe the following pattern

$$7 \times 9 = 9 \times 7,$$
$$23 \times 56 = 56 \times 23,$$
$$999 \times 888 = 888 \times 999$$

This can be generalised as $a \times b = b \times a$, where a, b are variables.

Try these

1. Identify the variables and constants among the following terms:

$a, 11-3x, xy, -89, -m, -n, 5, 5ab, -5, 3y, 8pqr, 18, -9t, -1, -8$

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2. Complete the following table:

S.No.	Verbal statements	Algebraic statements
1.	12 more than x	
2.		$m - 7$
3.		$2p + 1$
4.	Twice the sum of y and z.	
5.		$2k - 3$
6.	5 is reduced from the product of x and y	

Note : Algebraic statements are also known as Algebraic expressions.

3.1 Introduction

Consider the situation. Murugan's mother gave him ₹100 to buy 1 kilogram of sugar. If the shopkeeper returned ₹58, what is the price of sugar?

Let us see another situation. Jayashri wants to share chocolates among her friends on her birthday. She had ₹190 in her piggy bank. If she could buy 95 chocolates with that amount, then what is the price of one chocolate?

*Fig.*3.1

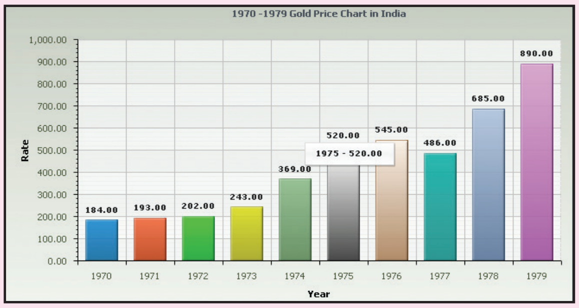
Did you get the answers? How did you work out?

You might have created numeric expressions like 100 – 58 = ? and 190 ÷ 95 = ? and then solved it. Isn't it? In both the cases, question mark (?) stands for an unknown value. Instead of using question marks everytime, we could use the letters like x, y, a, b ...

Let us learn more about this interesting branch of mathematics which deals with the methods of finding the unknown values.

MATHEMATICS ALIVE - ALGEBRA IN REAL LIFE

Weight of the Gold coin



Value of the Gold

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3.2 Terms and Co-efficients

We combine variables and constants using the mathematical operations addition and subtraction to construct **algebraic expressions.**

For example, the expression $6x + 1$ is obtained by adding two parts $6x$ and 1. Here $6x$ and 1 are known as **terms.** The term $6x$ is a variable and the term 1 is a constant, since it is not multiplied by a variable. Also we say that 6, x are the factors of the term $6x$.

Similarly, in the expression $3ab + 5c$, the terms are $3ab$ and $5c$. The factors of the term $3ab$ are 3, a and b. In the same way, the factors of the term $5c$ are 5 and c.

Now let us further try to understand the terms of an algebraic expression.

Observe the Fig.3.2

What is the perimeter of the given figure?

The perimeter, $'P'$ $= x + 5 + 6 + y + 5 + 4 + z + w$ *units,*

$= x + y + z + w + (5 + 6 + 5 + 4)$

$= x + y + z + w + 20,$

where x, y, z, w are variables and 20 is a constant.

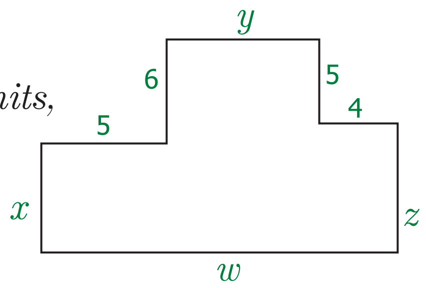

Fig.3.2

Note that, in the above expression, 5 terms are combined by using addition.

Consider another example as $6x - 5y + 3$. To find the terms of the expression, we write $6x + (-5y) + 3$. Here the terms are $6x$, $(-5y)$ and 3. An expression may have one, two, three or more terms.

Think

Can we use the operations multiplication and division to combine terms?

Also, a term may be any one of the following:

i) a constant such as $8, -11, 7, -1, \ldots$

ii) a variable such as $x, a, p, y, \ldots$

iii) a product of two or more variables such as $xy, pq, abc, \ldots$

iv) a product of constant and a variable/variables such as $5x, -7pq, 3abc, \ldots$

Note

An algebraic expression can have one term, two terms or more than two terms. An expression with one term is called a **monomial**, two terms is called a **binomial** and three terms is called a **trinomial**. An expression with one or more terms is called a **polynomial.** For example, the expression $2x$ is a **monomial,** $2x + 3y$ is a **binomial,** and $2x + 3y + 4z$ is a **trinomial.** All the expressions given above are polynomials.

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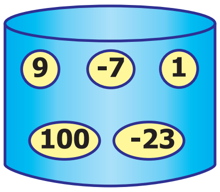
Activity

To further strengthen the understanding of variables and constants, let us do the following activity.

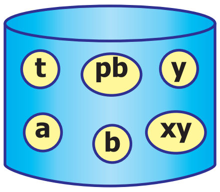
Consider, two baskets of cards. One containing constants and the other containing variables. Pick a constant from the first basket and a variable from the second basket and form a term by expressing it as a product. Write all the possible terms that can be constructed using the given constants and variables.

CONSTANTS



(Basket – 1)

VARIABLES



(Basket – 2)

– 7a	**100t**				

Try this

Complete the following table by forming expressions using the terms given. One is done for you.

Terms	Algebraic Expressions			
$7x, 2y, -5z$	$7x+2y$	$2y-5z$	$7x-5z$	$7x+2y-5z$
$3p, 4q, 5r$				
$9m, n, -8k$				
$a, -6b, 3c$				
$12xy, 9x, -y$				

Example 3.1 Identify the variables, terms and number of terms in each of the following expressions: (i) $12-x$ (ii) $7+2y$ (iii) $29+3x+5y$ (iv) $3x-5+7z$

Solution

S.No.	Expressions	Variables	Terms	No. of terms
(i)	$12-x$	x	$12, -x$	2
(ii)	$7+2y$	y	$7, 2y$	2
(iii)	$29+3x+5y$	x, y	$29, 3x, 5y$	3
(iv)	$3x-5+7z$	x, z	$3x, -5, 7z$	3

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3.2.1 Co-efficient of a term

A term of an algebraic expression is a product of factors. Here each factor or product of factors is called the **co-efficient** of the remaining product of factors.

For example, in the term $5xy$, 5 is the co-efficient of remaining factor product xy. Similarly x is the co-efficient of $5y$; $5x$ is the co-efficient of y. The constant 5 is called the **numerical co-efficient,** and others are called simply co-efficients.

A co-efficient can either be a numerical factor or an algebraic factor or product of both.

Since we often talk about the numerical co-efficients of a term, if we say "co-efficient", it will be understood that we are referring to the numerical co-efficient. If no numerical co-efficient appears in a term, then the co-efficient is understood to be 1.

Consider the term $-6ab$. It is the product of three factors -6, a and b. Also it can be written as a product of two factors such as $-6a \times b$, $-6b \times a$ and $-6 \times ab$.

The co-efficient of 'a' is $-6b$

The co-efficient of 'b' is $-6a$

The co-efficient of 'ab' is -6

Thus -6 is the **numerical co-efficient** in the term $-6ab$.

Example 3.2 Find the numerical co-efficient of the following terms. Also, find the co efficient of x and y in each of the term: $3x$, $-5xy$, $-yz$, $7xyz$, y, $16yx$.

Solution

Term	Numerical co-efficient	Co-efficient of x	Co-efficient of y
$3x$	3	3	Not possible
$-5xy$	-5	$-5y$	$-5x$
$-yz$	-1	Not possible	$-z$
$7xyz$	7	$7yz$	$7xz$
y	1	Not possible	1
$16yx$	16	$16y$	$16x$

3.3 Like and unlike terms

When you visit a market, you can see that, the vegetables and fruits of same kind are kept as separate heaps. Similarly, we can group the same kind of terms in an algebraic expression.

Fig.3.3

Fig.3.4

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For example, the expression $7x + 5x + 12x - 16$ has 4 terms but the first three terms have the same variable factor x. We say that $7x$, $5x$ and $12x$ are **like terms.**

However, the terms $12x$ and -16 have different variable factors. The term $12x$ has the variable x and the term -16 is a constant. Such terms are called **unlike terms.**

Consider another example. In the expression $14xy-7y-12yx+5y-10$, the terms $-7y$ and $5y$ are like terms. Also, $14xy$ and $-12yx$ are like terms. But, we cannot group the terms $14xy$, $7y$ and -10, as they do not have the same variables, thus called unlike terms.

Hence, the terms of an expression having the same variable(s) are called **like terms;** otherwise, they are called **unlike terms.** The following activity is helpful in identifying the like terms and unlike terms.

Try this

Identify the like terms among the following and group them: $7xy$, $19x$, 1, $5y$, x, $3yx$, 15, $-13y$, $6x$, $12xy$, -5, $16y$, $-9x$, $15xy$, 23, $45y$, $-8y$, $23x$, $-y$, 11.

Note

Terms with the variables xy and yx are like terms, because of the commutative property of multiplication $x \times y = y \times x$. Also, terms obey the commutative property of addition, that is $x + y = y + x$.

Points to remember while identifying like terms are as follows:

(i) In each of the term ignore numerical co-efficient.

(ii) Observe the algebraic variables of the terms. They must be the same. (Here the order in which the variables are multiplied should not be considered).

3.4 Value of an algebraic expression

Sometimes we would like to assign definite values to the variables in an expression to find the value of that expression. This situation arises in many real life problems.

For example, if the teacher of class 7 wants to select 10 students for a competition, for which she can choose any number of boys and girls.

If the number of boys are x and the number of girls are y, then the required algebraic expression to find the total number of participants is $x + y$.

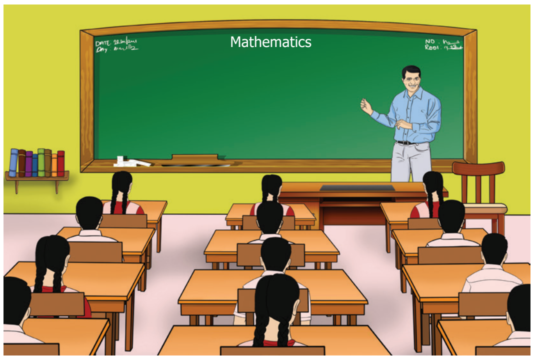

Fig.3.5

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Here, the total number of students to be selected is 10 and if only two girls are interested to participate in the competition, then how many boys should be selected? Obviously, if y = 2 then x + 2 = 10. The value x = 8 satisfies the equation. So, the number of boys to be selected is 8.

Follow the steps to obtain the value.

Step – 1: Study the problem. Fix the variable and write the algebraic expression.

Step – 2: Replace each variable by the given numerical value to obtain an numerical expression.

Step – 3: Simplify the numerical expression by **BIDMAS** method.

Step – 4: The value so obtained is the required value of the expression.

Try this

Try to find the value of the following expressions, if p = 5 and q = 6.

i) $p + q$ ii) $q - p$ iii) $2p + 3q$ iv) $pq - p - q$ v) $5pq - 1$

Example 3.3

If x = 3, y = 2 find the value of (i) $4x + 7y$ (ii) $3x + 2y - 5$ (iii) $x - y$

Solution

i) $4x + 7y = 4(3) + 7(2) = 12 + 14 = 26$

ii) $3x + 2y - 5 = 3(3) + 2(2) - 5 = 9 + 4 - 5 = 8$

iii) $x - y = 3 - 2 = 1$

Example 3.4

Find the value of (i) $3m + 2n$ (ii) $2m - n$ (iii) $mn - 1$, given that m = 2, n = − 1.

Solution

i) $3m + 2n = 3(2) + 2(-1) = 6 - 2 = 4$

ii) $2m - n = 2(2) - (-1) = 4 + 1 = 5$

iii) $mn - 1 = (2)(-1) - 1 = -2 - 1 = -3$

Exercise 3.1

1. Fill in the blanks:

(i) The variable in the expression $16x - 7$ is _________.

(ii) The constant term of the expression $2y - 6$ is __________.

(iii) In the expression $25m + 14n$, the type of the terms are _________ terms.

(iv) The number of terms in the expression $3ab + 4c - 9$ is _________.

(v) The numerical co-efficient of the term $-xy$ is _________.

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2. Say True or False.

(i) $x + (-x) = 0$

(ii) The co-efficient of ab in the term $15abc$ is 15.

(iii) $2pq$ and $-7qp$ are like terms

(iv) When $y = -1$, the value of the expression $2y - 1$ is 3

3. Find the numerical coefficient in each of the following terms: $-3yx$, $12k$, y, $121bc$, $-x$, $9pq$, $2ab$

4. Write the variables, constants and terms of the following expressions.

(i) $18 + x - y$ (ii) $7p - 4q + 5$ (iii) $29x + 13y$ (iv) $b + 2$

5. Identify the like terms among the following : $7x$, $5y$, $-8x$, $12y$, $6z$, z, $-12x$, $-9y$, 11z.

6. If $x = 2$ and $y = 3$, then find the value of the following expressions

(i) $2x - 3y$ (ii) $x + y$ (iii) $4y - x$ (iv) $x + 1 - y$

Objective type questions

7. An algebraic expressions which is equivalent to the verbal statement "Three times the sum of x and y" is

(i) $3(x + y)$ (ii) $3 + x + y$ (iii) $3x + y$ (iv) $3 + xy$

8. The numerical co-efficient of $-7mn$ is

(i) 7 (ii) -7 (iii) p (iv) $-$p

9. Choose the pair of like terms

(i) $7p$, $7x$ (ii) $7r$, $7x$ (iii) $-4x$, 4 (iv) $-4x$, $7x$

10. The value of $7a - 4b$ when $a = 3$, $b = 2$ is

(i) 21 (ii) 13 (iii) 8 (iv) 32

3.5 Addition and Subtraction of Algebraic expressions

We have discussed about algebraic expressions. Now, let us see how to add and subtract algebraic expressions.

Situation: Kannan has some number of beads and Aravind has 20 beads more than Kannan. Kavitha says that she has 3 more beads than the number of beads that Kannan and Aravind together have. How will you find the number of beads that Kavitha have.

Now we see that even though 3 persons are involved with 3 unknown quantities, we make use of one variable, since all the three variables are related.

Let that one variable be x which represents the number of beads that Kannan has.

Aravind has 20 more beads than Kannan. That is $x + 20$.

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Kavitha has 3 beads more than Kannan and Aravind have together. So, the number of beads that Kavitha has is given by $x+x+20+3$.

Now, we change the situation. Instead of Aravind has 20 more beads than Kannan, suppose Aravind has 20 beads less than Kannan.

If Kavitha has 3 beads more than what Kannan and Aravind have together, then find the number of beads that Kavitha has.

Now, Aravind has $x - 20$ beads. So, the number of beads that Kavitha has, is given by $x + x - 20 + 3$.

For example, to add $8ab$, $4ab$ and $2ab$, where ab is variable, we add the co-efficients alone, that is $8ab + 4ab + 2ab = (8 + 4 + 2)\ ab = 14\ ab = 14ab$.

In the same way, we can add the algebraic expressions. Let us try to add the expressions $11y + 7$ and $5y - 3$, where $11y$ and $5y$ are like terms with a variable y and 7 and -3 are constants (like terms).

Hence, $(11y + 7) + (5y - 3) = [11y + 5y] + [7 + (-3)]$
$= (11 + 5)\ y + (7 - 3)$
$= 16y + 4.$

Try this

Add the terms: i) $3p$, $14p$ ii) m, $12m$, $21m$ iii) $11abc$, $5abc$ iv) $12y$, $-y$ v) $4x$, $2x$, $-7x$

Example 3.5 Add the expressions: (i) $pq - 1$ and $3pq + 2$ (ii) $8x + 3$ and $1 - 7x$

Solution

i) $(pq - 1) + (3pq + 2) = (pq + 3pq) + (-1 + 2)$
$= (1 + 3)pq + 1$
$= 4pq + 1$

ii) $(8x + 3) + (1 - 7x) = 8x + 3 + 1 - 7x$
$= (8x - 7x) + (3 + 1)$
$= (8 - 7)\ x + 4$
$= x + 4.$

Subtraction of a term can be looked as addition of its additive inverse as we saw in subtraction of integers. To understand subtraction of algebraic expression, let us consider subtraction of algebraic expression with one term.

For example, to subtract $6y$ from $12y$, we can add $12y$ and $(-6y)$.

Thus we have, $12y + (-6y) = 12y - 6y$
$= (12 - 6)y = 6y.$

Now, let us subtract $-mn$ from $3mn$. Additive inverse of $-mn$ is mn. Hence, we have to add mn with $3mn$. Thus, $3mn + mn = (3 + 1)mn = 4mn$.

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Similarly, we can subtract two algebraic expressions. For example, to subtract $13a - 2$ from $25a + 11$, we have to add the additive inverse of $13a - 2$ with $25a + 11$.

Additive inverse of $13a - 2$ is $-(13a - 2) = -13a + 2$

$$\begin{aligned} \text{Therefore, } 25a + 11 - (13a - 2) &= (25a + 11) + (-13a + 2) \\ &= (25a - 13a) + (11 + 2) \\ &= 12a + 13 \end{aligned}$$

Note

1. Subtracting $4y$ is the same as adding $-4y$ and subtracting $-11x$ is the same as adding $11x$.
2. We know that, -3 is the additive inverse of 3. In the same way $-x$ is an additive inverse of x. Hence, x, $-x$ are equal in numerical value; but opposite in sign. Therefore, $x+(-x) = 0$. But, $x - (-x) = x+x = 2x$.

Example 3.6 Subtract: i) $7pq$ from $11pq$ ii) $-a$ from a iii) $5x + 7$ from $21x + 9$

Solution

i) $11pq - 7pq$. Additive inverse of $7pq$ is $-7pq$

$11pq + (-7pq) = 11pq - 7pq = (11 - 7)pq = 4pq$

ii) $a - (-a)$. Additive inverse of $-a$ is a.

So, $a + a = 2a$

iii) $21x + 9 - (5x + 7)$. Additive inverse of $5x + 7$ is $-(5x + 7)$.

$$\begin{aligned} (21x + 9) + [-(5x + 7)] &= (21x + 9) - (5x + 7) \\ &= 21x + 9 - 5x - 7 \\ &= (21 - 5)x + (9 - 7) \\ &= 16x + 2. \end{aligned}$$

Think

$3x + (y - x) = 3x + y - x$. But, $3x - (y - x) \neq 3x - y - x$. Why?.

Example 3.7 Simplify: $100x + 99y - 98z + 10x + 10y + 10z - x - y + z$

Solution In the given algebraic expression, x, y, z are the variables.

Let us group the like terms.

$$\begin{aligned} &100x + 99y - 98z + 10x + 10y + 10z - x - y + z \\ &= (100x + 10x - x) + (99y + 10y - y) + (-98z + 10z + z) \\ &= (100 + 10 - 1)x + (99 + 10 - 1)y + (-98 + 10 + 1)z \\ &= (110 - 1)x + (109 - 1)y + (-98 + 11)z \\ &= 109x + 108y + (-87)z \\ &= 109x + 108y - 87z. \end{aligned}$$

Note

For adding or subtracting algebraic expressions, we can write the like terms one after the other horizontally by using brackets or one below the other vertically.

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Example 3.8 i) Add: $3x - 4y + z$ and $2x - z + 3y$ ii) Subtract $2x - 5y$ from $4x + 3y$

Solution

i) $(3x - 4y + z) + (2x - z + 3y)$

$= (3x + 2x) + (-4y + 3y) + (z - z)$

$= (3 + 2)x + (-4 + 3)y + (1 - 1)z$

$= 5x - 1y + 0z$

$= 5x - y.$

Aliter :

$$\begin{array}{rrrr} & 3x & -4y & +z \\ (+) & 2x & +3y & -z \\ \hline & 5x & -y & +0 \end{array}$$

ii) $(4x + 3y) - (2x - 5y)$

$= (4x + 3y) + (-2x + 5y)$

$= (4x - 2x) + (3y + 5y)$

$= (4 - 2)x + (3 + 5)y$

$= 2x + 8y.$

Aliter :

$$\begin{array}{rrr} & 4x & +3y \\ (-) & +2x & -5y \\ & (-) & (+) \\ \hline & +2x & +8y \end{array}$$

Think

What will you get if twice a number is subtracted from thrice the same number?

Example 3.9

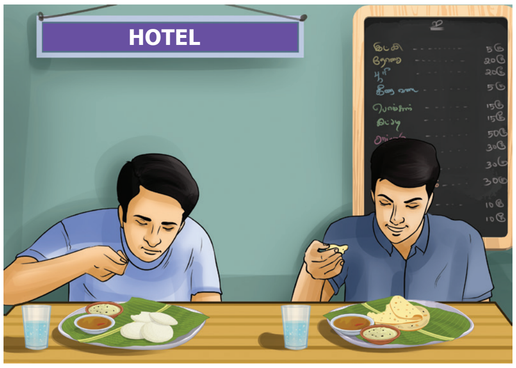

Fig.3.6

Mani and his friend Mohamed went to a hotel for dinner. Mani had 2 idlies and 2 dosas whereas Mohamed had 4 idlies and 1 dosa. If the price of each idly and dosa is x and y respectively, then find the bill amount in x and y.

Solution

Given that, the price of one idly is 'x' rupees and the price of one dosa is 'y' rupees

So, Mani's bill amount: $(2 \times x) + (2 \times y) = (2x + 2y)$

Mohamed's bill amount: $(4 \times x) + (1 \times y) = 4x + y$

Therefore, the total bill amount $= (2x + 2y) + (4x + y)$

$= (2 + 4)x + (2 + 1)y = 6x + 3y.$

Aliter:

In total, they had $2 + 4 = 6$ idlies. i.e. $6 \times x = 6x$

and $2 + 1 = 3$ dosas. i.e. $3 \times y = 3y$

Therefore, the total bill amount $= 6x + 3y.$

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Example 3.10

Rani earns ₹ 200 on the first day and spends some amount in the evening. She earns ₹ 300 on the second day and spends double the amount as she spents on the first day. She earns ₹ 400 on the third day and spends 4 times the amount as she spents on the first day. Can you give an algebraic expression of the total amount with her, at the end of the third day.

Solution

The amount earned on the first day is ₹ 200.

Let the amount spent on the first day be ₹ x. Amount with her at the end of the first day is $(200 - x)$.

Amount earned on the second day is ₹ 300 and the amount spent on the second day is ₹ $2x$. The amount left on the second day is $300 - 2x$.

Similarly, the net amount that she would have on the third day is $400 - 4x$. Therefore, the total amount that she would have at the end of three days is $(200 - x) + (300 - 2x) + (400 - 4x)$.

That is, $200 + 300 + 400 + (-1 - 2 - 4)x$

$$= 900 + (-7)x$$

Thus the required algebraic expression is $900 - 7x$.

Activity

Here is a magic number trick that you can perform using Algebra.

Choose any number of your choice	If it is 2	If it is 3	If it is 4	General term 'x'
Add 2 to this number	$2 + 2 = 4$	$3 + 2 = 5$	$4 + 2 = 6$	$x + 2$
Multiply the sum by 5	$4 \times 5 = 20$	$5 \times 5 = 25$	$6 \times 5 = 30$	$5(x + 2) = 5x + 10$
Add 10 to the product	$20 + 10 = 30$	$25 + 10 = 35$	$30 + 10 = 40$	$5x + 10 + 10 = 5x + 20 = 5(x+4)$
Divide the sum by 5	$\frac{30}{5} = 6$	$\frac{35}{5} = 7$	$\frac{40}{5} = 8$	$\frac{5(x+4)}{5} = x + 4$
Subtract the original number	$6 - 2 = 4$	$7 - 3 = 4$	$8 - 4 = 4$	$x + 4 - x = 4$
The final result is	4	4	4	4

Everyone will get the same result 4 irrespective of the number they think. Play this number game with your friends and surprise them. We generalized the pattern in the final column using algebraic expressions. Observe the same and create your own number game and verify whether it works for any number by finding the general term.

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Exercise 3.2

1. Fill in the blanks.

    (i) The addition of $-7b$ and $2b$ is __________

    (ii) The subtraction of $5m$ from $-3m$ is __________

    (iii) The additive inverse of $-37xyz$ is __________

2. Say True or False.

    (i) The expressions $8x + 3y$ and $7x + 2y$ can not be added.

    (ii) If x is a natural number, then $x + 1$ is its predecessor.

    (iii) Sum of $a - b + c$ and $-a + b - c$ is zero.

3. Add: (i) $8x$, $3x$ (ii) $7mn$, $5mn$ (iii) $-9y$, $11y$, $2y$

4. Subtract:

    (i) $4k$ from $12k$ (ii) $15q$ from $25q$ (iii) $7xyz$ from $17xyz$.

5. Find the sum of the following expressions

    (i) $7p + 6q$, $5p - q$, $q + 16p$

    (ii) $a + 5b + 7c$, $2a + 10b + 9c$

    (iii) $mn + t$, $2mn - 2t$, $-3t + 3mn$

    (iv) $u + v$, $u - v$, $2u + 5v$, $2u - 5v$.

    (v) $5xyz - 3xy$, $3zxy - 5yx$

6. Subtract

    (i) $13x + 12y - 5$ from $27x + 5y - 43$

    (ii) $3p + 5$ from $p - 2q + 7$

    (iii) $m + n$ from $3m - 7n$.

    (iv) $2y + z$ from $6z - 5y$.

7. Simplify

    (i) $(x + y - z) + (3x - 5y + 7z) - (14x + 7y - 6z)$

    (ii) $p + p + 2 + p + 3 - p - 4 - p - 5 + p + 10$

    (iii) $n + (m + 1) + (n + 2) + (m + 3) + (n + 4) + (m + 5)$

Objective type questions

8. The addition of $3mn$, $-5mn$, $8mn$ and $-4mn$ is

    (i) mn (ii) $-mn$ (iii) $2mn$ (iv) $3mn$

9. When we subtract 'a' from '$-a$', we get _______

    (i) 0 (ii) $2a$ (iii) $-2a$ (iv) $-a$

10. In an expression, we can add or subtract only…

    (i) Like terms (ii) Unlike terms (iii) All terms (iv) None of the above

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3.6 Simple linear equations

Now, let us learn to construct simple linear equations and solve them.

3.6.1 Construction of linear equations

Consider an expression $7x + 3$, where x is the variable.

When $x = 2$, the value of the expression is $(7 \times 2) + 3 = 14 + 3 = 17$.

Also, this can be written as $7x + 3 = 17$, when $x = 2$. $7x + 3 = 17$ is called an equation.

Moreover, no value of x other than 2 satisfies the Equation $7x + 3 = 17$. Thus $x = 2$ is called the **solution** to the equation $7x + 3 = 17$.

An equation, is always equated to either a numerical value or another algebraic expression. The equality sign shows that the value of the expression to the left of the '=' sign is equal to the value of the expression to the right of the '=' sign. In the above example, the expression $7x + 3$ on the left side is equal to the constant 17 on the right side.

In general, the RHS of an **equation** is just a number. But, this need not be always be so. The RHS may be an expression containing the variable. For example, the equation $7x + 3 = 3x - 1$ has the expression $7x + 3$ on the left and $3x - 1$ on the right separated by an equality sign.

Let us look at some situations where we have the value of an expression without actually knowing the values of each of the variables.

The cost of 10 chairs and 4 tables is ₹ 4000. We are not given the price of a chair or a table. Let us take the price of one chair as ₹ x and one table as ₹ y. Then the cost of 10 chairs and 4 tables is $10x + 4y$. Therefore, $10x + 4y = 4000$. This is an equation in two variables x and y taking the value 4000. Let us consider some more examples and find the algebraic equations.

1. "The cost of an apple and 2 mangoes is ₹ 120"

   If the price of an apple is a and one mango is m, then the required equation is $a + 2m = 120$.

Fig.3.7

2. "A rectangle of some dimensions has perimeter 50 cm".

   If l and b are the length and breadth of the rectangle then we write $2(l + b) = 50$.

3. "Thamarai is 4 years elder to her sister Selvi and sum of their ages is 24"

   The ages of Thamarai and her sister are treated as variables. Although, their ages are different, we consider this as one variable, because the age of Thamarai is associated to the age of Selvi.

   Suppose, if Selvi's age is 10, then the age of Thamarai is $10 + 4 = 14$. In the same way, if the age of Selvi is x, then the age of Thamarai is $x + 4$.

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Thus we can form an equation as $x + (x + 4) = 24$. Otherwise, $2x + 4 = 24$.

Hence an equation can be looked as algebraic expression equated to either a constant or any other algebraic expression.

Try these

Try to construct algebraic equations for the following verbal statements.

1. One third of a number plus 6 is 10
2. The sum of five times of x and 3 is 28.
3. Taking away 8 from y gives 11.
4. Perimeter of a square with side a is 16cm.
5. Venkat's mother's age is 7 years more than 3 times Venkat's age. His mother's age is 43 years.

3.6.2 Solving an equation

An equation is like a weighing balance with equal weights on both of its pans, in which case the arm of the balance are exactly horizontal.

If we add the same weights to both the pans, the arms remains horizontal. In the same way, if we remove the same weights from both the pans, then also the arm remains horizontal. We use the same principle for solving an equation.

We use the following principles to separate the variables and constants thereby solving an equation.

1. If we add or subtract the same number on both sides of the equation, the value remains the same. For example, to solve $x + 5 = 12$, we have to subtract 5 on both sides, for separating the constants and variables of the equation, that is $x + 5 - 5 = 12 - 5$.

   $x + 0 = 7$ Hence $x = 7$ [since 0 is the additive identity]

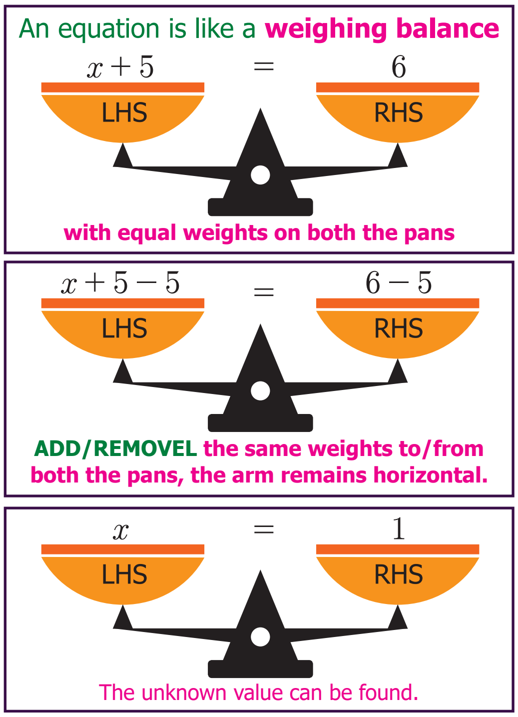

Fig.3.8

Think

Why should we subtract 5 and not some other number? Why don't we add 5 on both sides? Discuss.

2. Similarly, if we multiply or divide the equation with the same number on both sides, the equation remains the same. For example, to solve the equation $5y = 20$, divide by 5 on both sides.

   Thus we have $\frac{1}{\cancel{5}} \times \cancel{5}y = \frac{1}{5} \times 20$.

   $$y = \frac{20}{5}$$

   Therefore, $y = 4$

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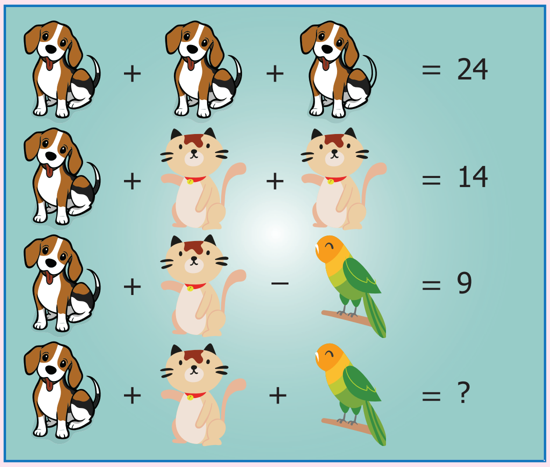
3. An equation remains the same, when the expressions on the left and on the right are interchanged. The equation $7x + 3 = 17$ is the same as $17 = 7x + 3$. Similarly, the equation $7x + 3 = 3x - 1$ is the same as $3x - 1 = 7x + 3$.

Try this

If the dogs, cats and parrots represent unknowns, find them. Substitute each of the values so obtained in the equations and verify the answers.



Example 3.11 Find two consecutive natural numbers whose sum is 75.

Solution The numbers are natural and consecutive. Let the numbers be x and $x + 1$.

Given that,

$$x + (x + 1) = 75$$

$$2x + 1 = 75$$

$$2x + 1 - 1 = 75 - 1 \quad \text{[Subtract 1 on both sides]}$$

$$2x + 0 = 74$$

$$\frac{2x}{2} = \frac{74}{2} \quad \text{[Divide by 2 on both sides]}$$

$$x = 37 \text{ and } x + 1 = 38$$

Therefore, the required numbers are 37 and 38.

Example 3.12

A person has ₹ 960 in denominations of ₹ 1, ₹ 5 and ₹ 10 notes. The number of notes in each denomination is equal. What is the total number of notes?

Solution Let the number of notes in each denomination be x.

$$\text{Then } x + 5x + 10x = 960$$

$$(1 + 5 + 10)x = 960$$

$$16x = 960$$

Divide by 16 on both the sides,

$$\frac{16x}{16} = \frac{960}{16}$$

$$\text{Therefore, } x = 60$$

Thus, the number of notes in each denomination is 60.

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Example 3.13

In an examination, a student scores 4 marks for every correct answer and loses one mark for every wrong answer. If he answers 60 questions in all and gets 130 marks, find the number of questions he answered correctly.

Solution Let the number of correct answers be x

Thus the number of wrong answers $= 60 - x$

$$\text{Then, } 4x - 1\,(60 - x) = 130$$
$$4x - 60 + x = 130$$
$$4x + x - 60 + 60 = 130 + 60 \quad \text{[Add 60 on both sides]}$$
$$5x + 0 = 190$$
$$5x = 190$$

Divide by 5 on both the sides,

$$\frac{5x}{5} = \frac{190}{5}$$
$$x = 38$$

Hence, the number of correct answer is 38.

Example 3.14

A school bus starts with full strength of 60 students. It drops some students at the first bus stop. At the second bus stop, twice the number of students get down from the bus. 6 students get down at the third bus stop and the number of students remaining in the bus is only 3. How many students got down at the first stop?

Solution

Since we do not know the number of students who get down at the first stop, let us take the number as x. The number of students get down at the second bus stop is $2x$.

Fig.3.9

$$x + 2x + 6 + 3 = 60$$
$$(1 + 2)\,x + 9 = 60$$
$$3x + 9 = 60$$
$$3x + 9 - 9 = 60 - 9 \quad \text{[Subtract 9 on both sides]}$$
$$3x = 51$$
$$\frac{3x}{3} = \frac{51}{3} \quad \text{[Divide by 3 on both sides]}$$
$$\text{Therefore, } x = 17.$$

Thus, the number of students got down in the first bus stop is 17.

Example 3.15

A cricket team won two matches more than they lost. If they win they get 5 points and for loss -3 points, how many matches have they played if their total score is 50.

Fig.3.10

Solution

Let the number of matches lost $= x$.

Then number of matches won $= x + 2$.

Given that, $5(x + 2) + (-3)x = 50$

$5x + 10 - 3x = 50$

$2x + 10 = 50$

$2x + 10 - 10 = 50 - 10$ (Subtract 10 on both sides)

$2x = 40$

Divide by 2 on both the sides, $x = 20$.

Therefore, the number of matches played is $x + x + 2 = 2x + 2$

$= (2 \times 20) + 2$

$= 40 + 2$

$= 42$.

Try this

Kandhan and Kavya are friends. Both of them are having some pens.

Kandhan : If you give me one pen, then we will have equal number of pens. Will you?

Kavya : But, if you give me one of your pens, then mine will become twice as yours. Will you?

Construct algebraic equations for this situation. Can you guess and find the actual number of pens, they have?

Exercise 3.3

1. Fill in the blanks.
   (i) An expression equated to another expression is called ___________
   (ii) If $a = 5$, the value of $2a + 5$ is ___________
   (iii) The sum of twice and four times of the variable x is ___________

2. Say True or False.
   (i) Every algebraic expression is an equation
   (ii) The expression $7x + 1$ can not be reduced without knowing the value of x.
   (iii) To add two like terms, its coefficients can be added.

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3. Solve:

(i) $x + 5 = 8$ (ii) $p - 3 = 7$ (iii) $2x = 30$ (iv) $\frac{m}{6} = 5$ (v) $7x + 10 = 80$

4. What should be added to $3x + 6y$ to get $5x + 8y$?

5. Nine added to thrice a whole number gives 45. Find the number.

6. Find two consecutive odd numbers whose sum is 200.

7. The taxi charges in a city comprise of a fixed charge of ₹ 100 for 5 kms and ₹ 16 per km for every additional km. If the amount paid at the end of the trip was ₹ 740 find the distance travelled.

Objective type questions

8. The generalization of the number pattern 3, 6, 9, 12,… is

(i) n (ii) $2n$ (iii) $3n$ (iv) $4n$

9. The solution of $3x + 5 = x + 9$ is

(i) 2 (ii) 3 (iii) 5 (iv) 4

10. The equation $y + 1 = 0$ is true only when y is

(i) 0 (ii) -1 (iii) 1 (iv) -2

Exercise 3.4

Miscellaneous Practice problems

1. Subtract $-3ab - 8$ from $3ab + 8$. Also, subtract $3ab + 8$ from $-3ab - 8$.

2. Find the perimeter of a triangle whose sides are $x + 3y$, $2x + y$, $x - y$.

3. Thrice a number when increased by 5 gives 44. Find the number.

4. How much smaller is $2ab + 4b - c$ than $5ab - 3b + 2c$

5. Six times a number subtracted from 40 gives -8. Find the number.

Challenge Problems

6. From the sum of $5x + 7y - 12$ and $3x - 5y + 2$, subtract the sum of $2x - 7y - 1$ and $-6x + 3y + 9$.

7. Find the expression to be added with $5a - 3b + 2c$ to get $a - 4b - 2c$?

8. What should be subtracted from $2m + 8n + 10$ to get $-3m + 7n + 16$?

9. Give an algebraic equation for the following statement:
" The difference between the area and perimeter of a rectangle is 20"

10. Add: $2a + b + 3c$ and $a + \frac{1}{3}b + \frac{2}{5}c$

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DO YOU KNOW?

Puzzles are instrumental for the origin of Algebra. **Leelavathi** is the first puzzle book in India written by Baskaracharya (Baskara II) who lived in Maharashtra during 12th century. The modified version of the interesting puzzle is for you.

"The beads from a pearl necklace fell down. One third of the pearls fell on the ground. One fifth of the pearls rolled under cot. Two persons started collecting the pearls. One person was able to collect one sixth and the other person collected one tenth of the pearls. If only 6 pearls are left in the necklace, find the total number of pearls in the necklace?"

Let the total number of pearls be x.

Using the given details, we can create an equation.

$$x-\left(\frac{x}{3}+\frac{x}{5}+\frac{x}{6}+\frac{x}{10}\right) = 6$$

$$x-x\left(\frac{10}{30}+\frac{6}{30}+\frac{5}{30}+\frac{3}{30}\right) = 6$$

LCM taken for 5,6,3,10 is 30.

So, $$x\left(1-\frac{24}{30}\right) = 6$$

$$x\left(\frac{30-24}{30}\right) = 6$$

$$x\left(\frac{6}{30}\right) = 6$$

$$x\left(\frac{1}{5}\right) = 6$$

$$x = 6 \times 5 = 30 \text{ pearls}$$

Summary

- A symbol having a fixed numerical value is called a constant, and a symbol which takes various numerical values is called a variable.
- Variables and constants are combined by the operations addition and subtraction to construct an algebraic expression.
- Any mathematical formula, rule or pattern can be generalized using an algebraic expression.
- The parts of an algebraic expression which are combined by the signs '+' or '–' are called the terms of the expressions.
- In a term of an algebraic expression, each factor or group of factors is called the co-efficient of the remaining factors. The number in the variable term is called the numerical co-efficient.
- The terms having the same algebraic factors are called like terms. Terms with different algebraic factors are called unlike terms.
- We can add or subtract like terms only. Unlike terms cannot be added or subtracted.
- An equation can be looked as algebraic expression equated either to a constant or to any other algebraic expression.
- To solve an equation, we can add or subtract or multiply or divide the same number on both sides of the equation.

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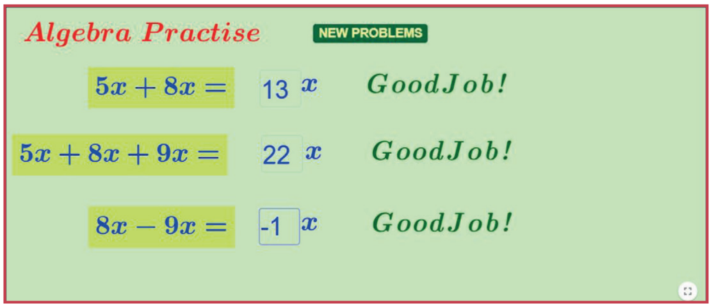
ICT Corner

Expected Result is shown in this picture



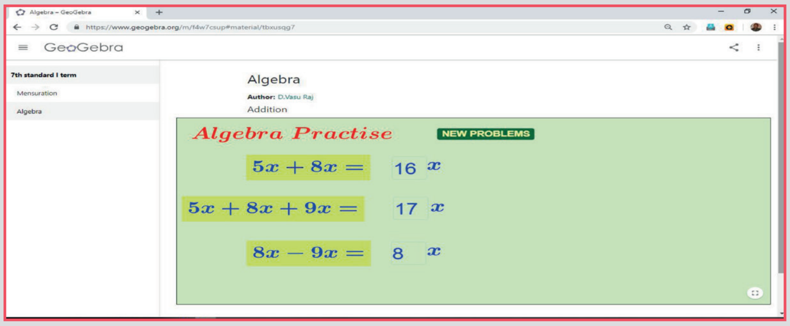
Step – 1 :

Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "7th std Algebra" will open. Click on "NEW PROBLEMS" to get new questions.

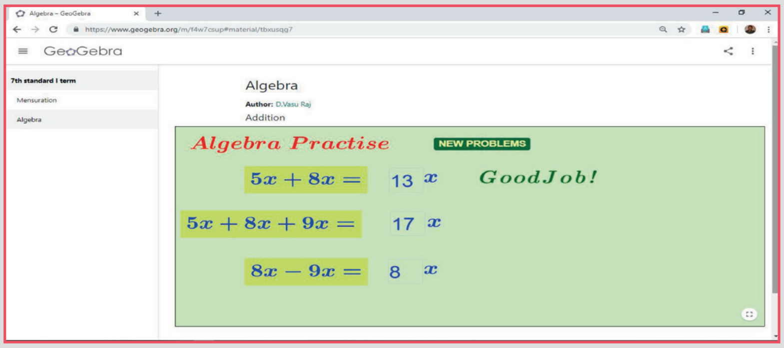
Step - 2 :

Enter the correct number in the input box and enter. If the answer is correct It will show " Great Job". Practice more and more problems.

Step 1



Step 2



Browse in the link

Algebra: https://ggbm.at/tbxusqg7
or Scan the QR Code.

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$\frac{x_1}{y_1} = \frac{x_2}{y_2}$

Chapter

4 Direct and Inverse Proportion

$\frac{x_1}{y_1} = \frac{x_2}{y_2}$

5DFXR

Learning objectives

- To recall the concept of ratio and proportion.
- To understand the concept of direct and inverse proportion.
- To be able to differentiate direct proportion and inverse proportion.
- To solve application problems using direct and inverse proportion.

Recap

Ratio and Proportion

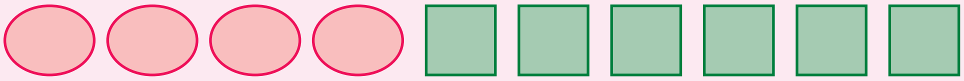
In class VI we have learnt ratio and proportion. Let us recall them now.

Ratio is the comparison of two quantities of the same kind. If the quantity 'a' is compared with the quantity 'b', the ratio can be written in the form $a : b$ (read as a is to b)

When two ratios $a : b$ and $c : d$ are equal then we say that the ratios are in proportion. This is denoted as $a : b :: c : d$ and it is read as 'a is to b is as c is to d'. In $a : b :: c : d$, product of the means is equal to product of the extremes, that is $bc = ad$.

Try these

1. Find the ratio of the number of circles to number of squares.



2. Find the ratio (i) 555 g to 5 kg (ii) 21 km to 175 m
3. Find the value of 'x' in the following proportions.

   (i) $110 : x :: 8 : 88$ (ii) $x : 26 :: 5 : 65$

4.1 Introduction

We come across many situations in day-to-day life where we see a change in one quantity brings a change in the other quantity. Let us learn more about the concept of variation that helps us to handle situations efficiently.

Now, let us consider such situations which we come across in every day life.

We consider the task of cleaning a school,

(i) when more number of students are involved, the time taken to clean will be less.

(ii) when the number of students are more, the work done will also be more.

In the first case, number of students is compared with time taken and in the second case, the number of students is compared with the amount of work. The quantities taken for comparison decides the type of variation.

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Situation 1 Manimala prepares vegetable soup for her family of 4 members. She uses 2 cup of vegetables, 600 ml of water, 1 teaspoon of salt and $\frac{1}{2}$ teaspoon of pepper. Suddenly her aunt and uncle join them. What would be the change in quantities of the ingredients to prepare soup for all the six members?

Situation 2 In a military camp there are 200 soldiers. Grocery for them are available for 40 days. If 50 more soldiers join them, how long will these grocery last?

In the above situations a change in one quantity results in the corresponding change in other quantity. That is in situation 1, more the number of members, more will be the quantity of items. In situation 2, the more number of soldiers in the group, the grocery needed will be more and so it will last for less number of days.

In these situations when one quantity varies that brings a change in other quantity in two ways, that is,

(i) both the quantities increase or decrease.

(ii) increase in one quantity causes decrease in the other quantity or vice-versa.

If such quantities varies in constant ratio, they are said to be in proportion. Two different variations give rise to two types of proportion which will be discussed now.

MATHEMATICS ALIVE-DIRECT AND INVERSE PROPORTION IN REAL LIFE

Direct proportion

Inverse proportion

4.2 Direct Proportion

For example, if the cost of a shirt is ₹ 500, then the price of 3 shirts will be ₹ 1,500. The price of the shirts increases as the number of shirts increases. Proceeding the same way we can find the cost of any number of such shirts.

When observing the above situation, two quantities namely the number of shirts and their prices are related to each other. When the number of shirts increases, the price also increases in such a way that their ratio remains constant.

Let us denote the number of shirts as x and the price of shirts as y rupees. Now observe the following table

Number of shirts (x)	1	2	3	6	7	...
Price of shirts in ₹ (y)	500	1000	1500	3000	3500	...

From the table, we can observe that when the values of x increases the corresponding values of y also increases in such way that the ratio $\frac{x}{y}$ in each case has the same value

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which is a constant (say k). Now let us find the ratio for each of the value from the table.

$\frac{x}{y} = \frac{1}{500} = \frac{2}{1000} = \frac{3}{1500} = \frac{6}{3000} = \frac{7}{3500}$ and so on. All the ratios are equivalent and its simplified form is $\frac{1}{500}$.

In general, $\frac{x}{y} = \frac{1}{500} = k$ (k is a constant)

When x and y are in direct proportion, we get $\frac{x}{y} = k$ or $x = ky$ (k is a constant)

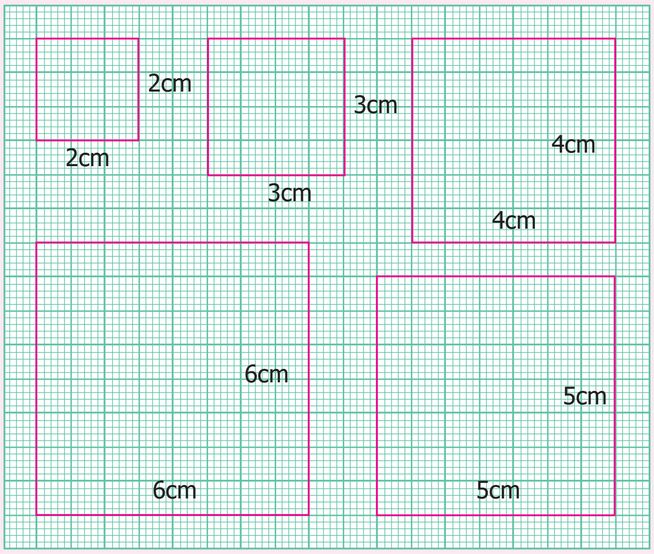
Considering any two ratios given above, say, $\frac{2}{1000} = \frac{6}{3000}$, where 2($x_1$) and 6 ($x_2$) are the number of shirts (x) and 1000 (y_1) and 3000 (y_2) are their prices (y). So, when x and y are in direct proportion we can write $\frac{x_1}{y_1} = \frac{x_2}{y_2}$ [where, y_1, y_2 are values of y corresponding to the values x_1, x_2 of x].

Think

The number of chocolates to be distributed to the number of children. Is this statement in direct proportion?

Try this

Observe the following 5 squares of different sides given in the graph sheet



The measures of the sides are recorded in the table given below. Find the corresponding perimeter and the ratios of each of these with the sides given and complete the table.

Side of the square (x) in cm	2	3	4	5	6
Perimeter of the square (y) in cm					
$\frac{x}{y}$					

From the information so obtained state whether the side of a square is in direct proportion to the perimeter of the square

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Think

When a fixed amount is deposited for a fixed rate of interest, the simple interest changes propotionaly with the number of years it is being deposited. Can you find any other examples of such kind.

Example 4.1

If 6 children shared 24 pencils equally, then how many pencils are required for 18 children?

Solution

Let x be the number of pencils required for 18 children. As the number of children increases, number of pencils also increases.

In the case of direct proportion we take $\frac{x_1}{y_1} = \frac{x_2}{y_2}$

Number of children	6	18
Number of pencils	24	x

$$\frac{6}{24} = \frac{18}{x}$$

$$\frac{6 \times x}{24} = 18$$

$$x = \frac{18 \times 24}{6} = 72$$

Hence, 72 pencils are required for 18 children.

Example 4.2

If 15 chart papers together weigh 50 grams, how many of the same type will be there in a pack of $2\frac{1}{2}$ kilogram?

Solution

Let x be the required number of charts.

Number of chart papers	15	x
Weight in grams	50	2500

As weight increases, the number of charts also increases. So the quantities are in direct proportion.

Hence $\frac{x_1}{y_1} = \frac{x_2}{y_2}$

$$\frac{15}{50} = \frac{x}{2500}$$

$$15 \times 2500 = x \times 50$$

$$x \times 50 = 15 \times 2500$$

$$x = \frac{15 \times 2500}{50} = 750$$

Therefore, 750 charts will weigh $2\frac{1}{2}$ kilogram.

Unitary Method

We know the concept of unitary method studied in the previous class.

First, the value of one unit will be found. It will be useful to find the value of the required number of units. We will try to solve more problems using unitary method.

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Example 4.3

Anbu bought 2 notebooks for ₹ 24. How much money will be needed to buy 9 such notebooks?

Solution Using unitary method we can solve this as follows:

The cost of 2 notebooks = ₹ 24

The cost of 1 notebook = $\frac{24}{2}$ = ₹ 12

Therefore, the cost of 9 notebooks = 9 × ₹ 12

= ₹ 108

Hence, Anbu has to pay ₹108 for 9 notebooks.

Example 4.4

A car travels 90km in 2hours 30minutes. How much time is required to cover 210km?

Solution Time taken to cover 90 km = 2hrs 30mins

= 150 minutes

1 hour = 60 minutes	
2 hours = 120 minutes	

Time taken to cover 1 km = $\frac{150}{90}$ minutes.

Time taken to cover 210 km = $\frac{150}{90} \times 210$ minutes

= 350 minutes

= 5 hours 50 minutes

Thus, the time taken to travel 210 km is 5 hours 50 minutes

Exercise 4.1

1. Fill in the blanks
   (i) If the cost of 8 apples is ₹ 56 then the cost of 12 apples is ________.
   (ii) If the weight of one fruit box is $3\frac{1}{2}$ kg, then the weight of 6 such boxes is ______.
   (iii) A car travels 60 km with 3 liters of petrol. If the car has to cover the distance of 200 km, it requires _______ liters of petrol.
   (iv) If the cost of 7 m cloth is ₹ 294, then the cost of 5 m of cloth is ______.
   (v) If a machine in a cool drinks factory fills 600 bottles in 5 hrs, then it will fill ______ bottles in 3 hours.
2. Say True or False
   (i) Distance travelled by a bus and time taken are in direct proportion.
   (ii) Expenditure of a family to number of members of the family are in direct proportion.
   (iii) Number of students in a hostel and consumption of food are not in direct proportion.

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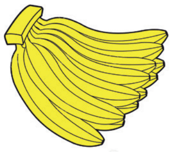
(iv) If Mallika walks 1 km in 20 minutes, then she can cover 3 km in 1 hour.

(v) If 12 men can dig a pond in 8 days, then 18 men can dig it in 6 days.



3. A dozen bananas costs ₹ 20. What is the price of 48 bananas?
4. A group of 21 students paid ₹ 840 as the entry fee for a magic show. How many students entered the magic show if the total amount paid was ₹ 1,680?
5. A birthday party is arranged in third floor of a hotel. 120 people take 8 trips in a lift to go to the party hall. If 12 trips were made how many people would have attended the party?
6. The shadow of a pole with the height of 8 m is 6m. If the shadow of another pole measured at the same time is 30m, find the height of the pole?
7. A postman can sort out 738 letters in 6 hours. How many letters can be sorted in 9 hours?
8. If half a meter of cloth costs ₹ 15. Find the cost of $8\frac{1}{3}$ meters of the same cloth.
9. The weight of 72 books is 9kg. what is the weight of 40 such books? (using unitary method)
10. Thamarai pays ₹ 7500 as rent for 3 months. With the same rate how much does she have to pay for 1 year? (using unitary method).
11. If 30 men can reap a field in 15 days, then in how many days can 20 men reap the same field?
12. Valli buys 10 pens for ₹ 180 and Kamala buys 8 pens for ₹ 96. Can you say who bought the pen cheaper? (using unitary method)
13. A motorbike requires 2 litres of petrol to cover 100 kilometers. How many litres of petrol will be required to cover 250 kilometers? (using unitary method)

Objective type questions

14. If the cost of 3 books is ₹ 90, then find the cost of 12 books.
    (i) ₹ 300 (ii) ₹ 320 (iii) ₹ 360 (iv) ₹ 400
15. If Mani buys 5kg of potatoes for ₹ 75 then he can buy ______kg of potatoes for ₹ 105.
    (i) 6 (ii) 7 (iii) 8 (iv) 5
16. 35 cycles were produced in 5 days by a company then______ cycles will be produced in 21 days.
    (i) 150 (ii) 70 (iii) 100 (iv) 147
17. An aircraft can accommodate 280 people in 2 trips. It can take ______trips to take 1400 people.
    (i) 8 (ii) 10 (iii) 9 (iv) 12
18. Suppose 3 kg. of sugar is used to prepare sweets for 50 members, then ____ kg. of sugar is required for 150 members.
    (i) 9 (ii) 10 (iii) 15 (iv) 6

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4.3 Inverse Proportion

Let us consider the following situation.

Situation The following table shows the number of workers and the number of days to finish the construction of water tank in school.

Number of workers (x)	2	4	5	10
Number of days (y)	40	20	16	8

ALYF1

In this situation, the two quantities namely number of workers and the number of days are related to each other. We observe that when the number of workers increases, the number of days to finish the job decreases. Consider the number of workers as x and the number of days as y then we note that the product is always the same. That is,

$$x \times y = 2 \times 40 = 4 \times 20 = 5 \times 16 = 10 \times 8$$

Consider each of the value of x and the corresponding value of y. Their products are all equal say $xy = 80 = k$ (k is a constant) and it can be expressed as $xy = k$ (k is a constant)

If y_1 and y_2 are the values of y corresponding to the values of x_1 and x_2 of x respectively then $x_1 y_1 = x_2 y_2$ (=k) $\frac{x_1}{y_1} = \frac{x_2}{y_2}$. We say that x and y are in inverse proportion.

Think

Think of an example in real life where two variables are inversely proportional.

Try these

1. Complete the table given below and find the type of proportion

No. of chocolates	1	___	3	4	5	___	____ proportion
Price in rupees (₹)	5	10	___	20	___	___	

No. of workers	1	2	4	5	___	___	____ proportion
Time in hours	20	___	5	___	2	1	

2. Read the following examples and group them in two categories

S. No.	Quantities	Direct proportion	Inverse proportion
1.	Number of note books purchased and its cost.		
2.	Food shared by number of students to the fixed quantity of food.		
3.	Number of boxes of same size and their weight		
4.	Number of uniforms to the number of students.		
5.	Speed of a vehicle and the time taken to cover the fixed distance		

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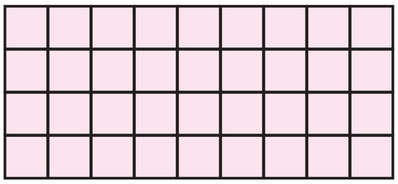
Activity

Form all possible rectangles with area 36 sq.cm by completing the following table.

Length	36	18		9
Breadth	1		3	



Observe and answer the following

(i) When length decreases, the breadth ________

(ii) When breadth increases, the length ________

(iii) If the length is 8 cm what will be the breadth? -Discuss.

Extend this activity and try the same with area 24 and 48 sq.units.

Example 4.5

60 workers can spin a bale of cotton in 7 days. In how many days will 42 workers spin it?

Solution

Let x be the required number of days. The decrease in number of workers lead to the increase in number of days. (Therefore, both are in inverse proportion)

Number of workers	60	42
Number of days	7	x

For inverse proportion $x_1y_1 = x_2y_2$

Hence $60 \times 7 = 42 \times x$

$$42 \times x = 60 \times 7$$

$$x = \frac{60 \times 7}{42}$$

$$x = 10$$

In 10 days 42 workers can spin a bale of cotton.

Example 4.6

The cost of 1 box of tomato is ₹ 200. Vendan had money to buy 13 boxes. If the cost of the box is increased to ₹ 260 then how many boxes will he buy with the same amount?

Solution

The cost of one box = ₹ 200

Increased cost of one box = ₹ 260

Let x be the number of boxes bought by Vendan.

As cost of boxes increases the number of boxes decreases.

This is in inverse proportion. Therefore, $x_1y_1 = x_2y_2$

Number of boxes	13	x
Cost in ₹	200	260

$$13 \times 200 = x \times 260$$

$$x \times 260 = 13 \times 200$$

$$x = \frac{13 \times 200}{260}$$

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$$x = 10$$

Therefore, he can buy 10 boxes for the same amount.

DO YOU KNOW?

Direct and indirect proportion is very much useful in project scheduling. A project can be any work that is time bound like building a house, construction of bridges, etc.

Exercise 4.2

1. Fill in the blanks.
   (i) 16 taps can fill a petrol tank in 18 minutes. The time taken for 9 taps to fill the same tank will be ________ minutes.
   (ii) If 40 workers can do a project work in 8 days, then________ workers can do it in 4 days.
2. 6 pumps are required to fill a water sump in 1 hr 30 minutes. What will be the time taken to fill the sump if one pump is switched off?
3. A farmer has enough food for 144 ducks for 28 days. If he sells 32 ducks, how long will the food last?
4. It takes 60 days for 10 machines to dig a hole. Assuming that all machines work at the same speed, how long will it take 30 machines to dig the same hole?
5. Forty students stay in a hostel. They had food stock for 30 days. If the students are doubled then for how many days the stock will last?
6. Meena had enough money to send 8 parcels each weighing 500 grams through a courier service. What would be the weight of each parcel, if she has to send 40 parcels for the same money?
7. It takes 120 minutes to weed a garden with 6 gardeners If the same work is to be done in 30 minutes, how many more gardeners are needed?
8. Neelaveni goes by bi-cycle to her school every day. Her average speed is 12km/hr and she reaches school in 20 minutes. What is the increase in speed, if she reaches the school in 15 minutes?
9. A toy company requires 36 machines to produce car toys in 54 days. How many machines would be required to produce the same number of car toys in 81 days?

Objective type questions

10. 12 cows can graze a field for 10 days. 20 cows can graze the same field for______ days.

    (i) 15 (ii) 18 (iii) 6 (iv) 8

11. 4 typists are employed to complete a work in 12 days. If two more typists are added, they will finish the same work in ________ days.

    (i) 7 (ii) 8 (iii) 9 (iv) 10

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Exercise 4.3

Miscellaneous Practice problems

1. If the cost of 7kg of onions is ₹ 84 find the following

   (i) Weight of the onions bought for ₹ 180 (ii) The cost of 3 kg of onions

2. If C =kd, (i) what is the relation between C and d?
   (ii) find k when C = 30 and d = 6 (iii) find C, when d = 10

2HLQC

3. Every 3 months Tamilselvan deposits ₹ 5000 as savings in his bank account. In how many years he can save ₹ 1,50,000.

4. A printer, prints a book of 300 pages at the rate of 30 pages per minute. Then, how long will it take to print the same book if the speed of the printer is 25 pages per minute?

5. If the cost of 6 cans of juice is ₹ 210, then what will be the cost of 4 cans of juice?

6. x varies inversly as twice of y. Given that when y = 6, the value of x is 4. Find the value of x when y = 8.

7. A truck requires 108 liters of diesel for covering a distance of 594km. How much diesel will be required to cover a distance of 1650km?

Challenge Problems

8. If the cost of a dozen soaps is ₹ 396, what will be the cost of 35 such soaps?

9. In a school, there is 7 period a day each of 45 minutes duration. How long each period is, if the school has 9 periods a day assuming the number of hours to be the same?

10. Cost of 105 notebooks is ₹ 2415. How many notebooks can be bought for ₹ 1863?

11. 10 farmers can plough a field in 21 days. Find the number of days reduced if 14 farmers ploughed the same field?

12. A flood relief camp has food stock by which 80 people can be benefited for 60 days. After 10days 20 more people have joined the camp. Calculate the number of days of food shortage due to the addition of 20 more people?

13. Six men can complete a work in 12 days. Two days later, 6 more men joined them. How many days will they take to complete the remaining work?

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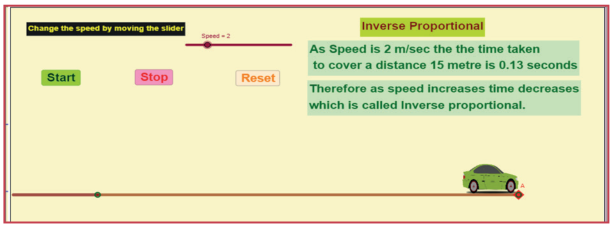
Summary

- A change in one quantity results a corresponding change in other quantity is called proportion.
- Two quantities x and y are said to be in direct proportion with each other if they increase or decrease together in such a way that $\frac{x}{y}$ remains constant.
- Two quantities x and y are said to be in inverse proportion if an increase in x leads to a decrease in y (or vice versa) in such a way that, the product xy remains constant.

ICT Corner

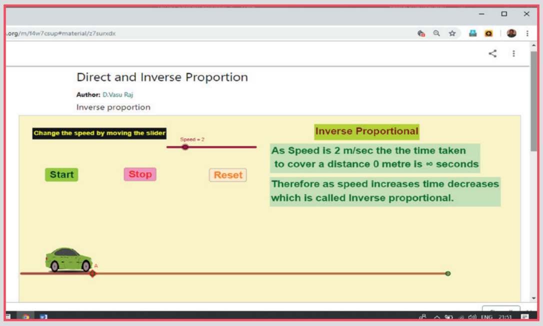
Expected Result is shown in this picture



Step 1

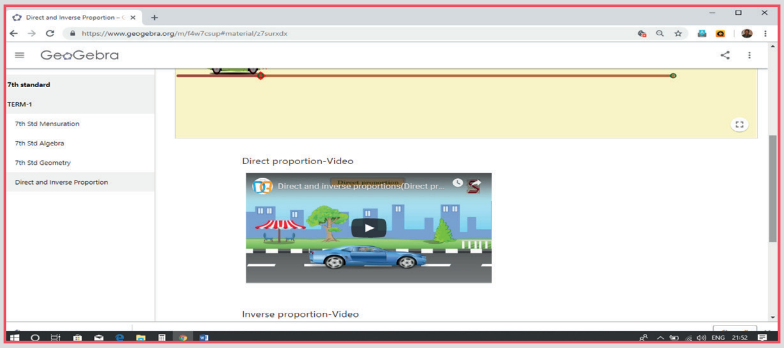
Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Direct and Inverse Proportion" will open. There is one activity for Inverse proportion and two videos.

In the activity "Inverse proportion", Move the slider to change the speed of the car. Click Start button to move the car at desired speed. Observe the time taken when the speed is increased.



Step 2

In the second and third page two videos for Direct and inverse proportion are given. Go through the video and compare what you learned from book.



Browse in the link

Direct and Inverse proportion https://ggbm.at/z7surxdx
or Scan the QR Code.

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Chapter

5

GEOMETRY

NX9KM

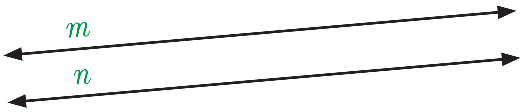
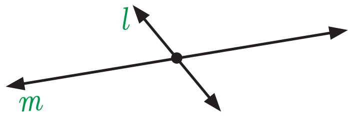
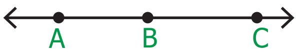
Learning objectives

- To understand about adjacent angles, linear pair and vertically opposite angles.
- To understand transversal.
- To identify the different types of angles formed by a pair of lines with a transversal.
- To construct perpendicular bisector of a given line segment.
- To construct angle bisector of a given angle.
- To construct special angles such as 90°, 60°, 30° and 120° without using protractor.

Recap

Lines

Let us recall the following concepts on lines and points which we have learnt in class VI.

A **line** extends along both directions without any end. A line AB is denoted by $\overleftrightarrow{AB}$. Sometimes small letters like l, m, n and so on are used to denote lines.	
A **line segment** has two end points. The line segment 'AB' is represented by $\overline{AB}$.	
A **Ray** is a line that starts from a point 'A' and extends without any end in a particular direction passing through 'B' which is denoted by $\overrightarrow{AB}$.	
If two lines m and n are parallel, then we denote it as $m \| n$. **Parallel lines** never intersect each other.	
When two lines have a common point they are called **intersecting lines** and that point is called the point of intersection of the given two lines.	
If three or more points lie on the same line, then they are called **collinear points**; otherwise they are called **non-collinear points**.	 A,B and C are collinear points P,Q and R are non-collinear points

Try these

1. Complete the following statements.

   (i) A ________ is a straight path that goes on endlessly in two directions.

   (ii) A ________ is a line with two end points.

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(iii) A _____ is a straight path that begins at a point and goes on and extends endlessly in the other direction.

(iv) The lines which intersect at right angles are ____________.

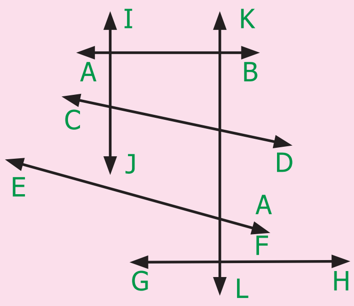
(v) The lines which intersect each other at a point are called _________.

(vi) The lines that never intersect are called ___________.

2. Use a ruler or straightedge to draw each figure.

(i) line CD (ii) ray AB (iii) line segment MN

3. Look at the figure and answer the following questions.



(i) Which line is parallel to AB

(ii) Name a line which intersect CD

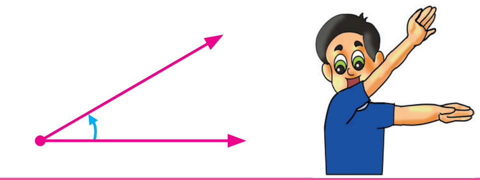
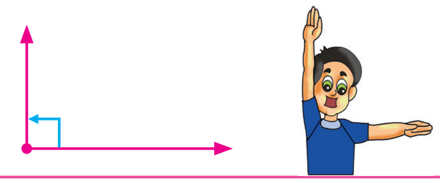
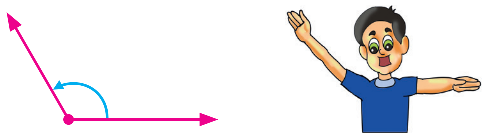
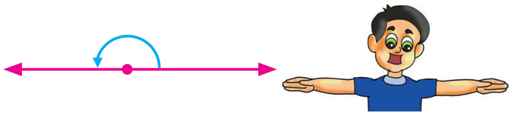
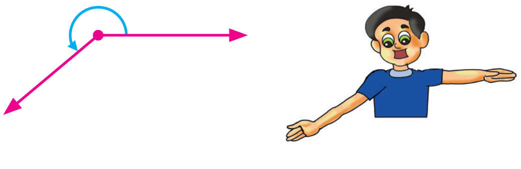
(iii) Name the lines which are perpendicular to GH

(iv) How many lines are parallel to IJ

(v) Will EF intersect AB? Explain.

Angles

Recall that **an angle** is formed when two rays diverge from a common point. The rays forming an angle are called the **arms** of the angle and the common point is called the **vertex** of the angle. You have studied different types of angles, such as **acute angle, right angle, obtuse angle, straight angle** and **reflex angle,** in class VI. We can summarize them as follows:

Acute angle An angle whose measure is less than 90º is called an acute angle.	
Right angle An angle whose measure is exactly 90º is called a right angle.	
Obtuse angle An angle whose measure is greater than 90° and less than 180° is called an obtuse angle.	
Straight angle An angle whose measure is exactly 180° is called a straight angle.	
Reflex angle An angle whose measure is greater than 180° and less than 360° is called a reflex angle.	

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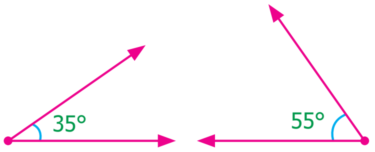
Also, we have studied about related angles such as complementary and supplementary angles in our previous class. Let us recall them.

Complementary angles

Two angles are called Complementary angles if their sum is 90°.

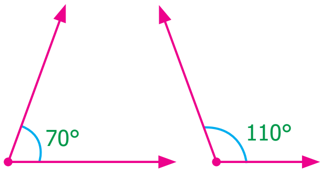
Are the two angles given in the figure complementary? Yes. The pair of angles 35° and 55° are complementary, where the angle 35° is said to be the complement of the other angle 55° and vice versa.



Supplementary angles

Two angles are called Supplementary angles if their sum is 180°.

Observe the sum of measures of the angles 70° and 110° given in the figure is 180°. When two angles are supplementary, each angle is said to be the supplement of the other.



Try these

Choose the correct answer.

1. A straight angle measures

   (a) 45° (b) 90° (c) 180° (d) 100°

2. An angle with measure 128° is called ____________ angle.

   (a) a straight (b) an obtuse (c) an acute (d) Right

3. The corner of the A4 paper has

   (a) an acute angle (b) a right angle (c) straight (d) an obtuse angle

4. If a perpendicular line is bisecting the given line, you would have two

   (a) right angles (b) obtuse angles (c) acute angles (d) reflex angles

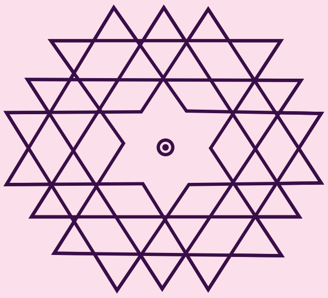
5. An angle that measure 0° is called ________.

   (a) right angle (b) obtuse angle (c) acute angle (d) zero angle

5.1 Introduction

We are familiar with complementary and supplementary angles. Let us see some more related pairs of angles now.

MATHEMATICS ALIVE - GEOMETRY IN REAL LIFE



Beauty of Angles in architecture and kolams

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5.2 Pair of Angles formed by Intersecting Lines

We are going to study related angles such as adjacent angles, linear pair of angles and vertically opposite angles.

V8U1B

5.2.1. Adjacent angles

The teacher shows a picture of sliced orange with angles marked on it.

Read the conversation between the teacher and students.

Teacher : How many angles are marked on the picture? Can you name them?

Kavin : Three angles are marked on the picture. They are $\angle AOC, \angle AOB$ and $\angle BOC$

Teacher : Which are the angles seen next to each other?

Thoorigai : Angles such as $\angle AOB$ and $\angle BOC$ are next to each other.

Teacher : How many vertices are there?

Mugil : There is only one common vertex.

Teacher : How many arms are there? Name them.

Amudhan : There are three arms. They are $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$

Teacher : Is there any common arm for $\angle AOB$ and $\angle BOC$?

Oviya : Yes. $\overrightarrow{OB}$ is the common arm for $\angle AOB$ and $\angle BOC$.

Teacher : What can you say about the arms $\overrightarrow{OA}$ and $\overrightarrow{OC}$?

Kavin : They lie on the either side of the common arm $\overrightarrow{OB}$.

Teacher : Are the interiors of $\angle AOB$ and $\angle BOC$ overlapping?

Mugil : No. Their interiors are not overlapping.

Teacher : Hence the two angles, $\angle AOB$ and $\angle BOC$ have one common vertex (O), one common arm ($\overrightarrow{OB}$), other two arms ($\overrightarrow{OA}$ and $\overrightarrow{OC}$) lie on either side of the common arm and their interiors do not overlap.

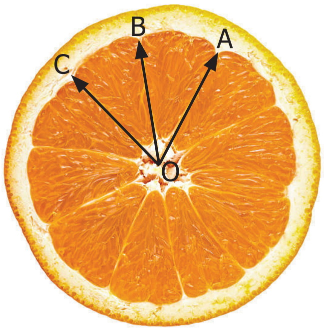


Fig.5.1

Such pair of angles $\angle AOB$ and $\angle BOC$ are called adjacent angles.

So, two angles which have a common vertex and a common arm, whose interiors do not overlap are called adjacent angles.

Now observe the Fig.5.2 in which angles are named $\angle 1$, $\angle 2$ and $\angle 3$.

It can be observed that there are two pairs of adjacent angles such as $\angle 1$, $\angle 2$ and $\angle 2$, $\angle 3$. Then what about the pair of angles $\angle 1$ and $\angle 3$?

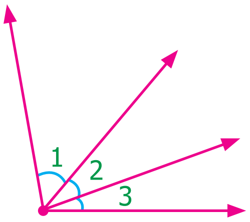
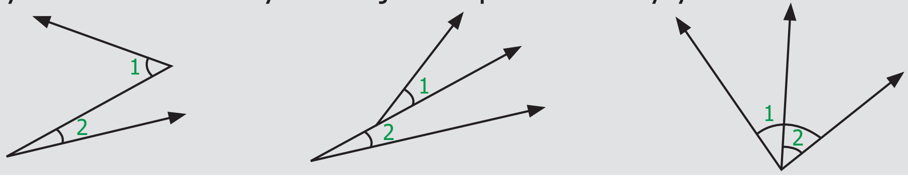


Fig.5.2

They are not adjacent because this pair of angles have a common vertex but they do not have a common arm as $\angle 2$ is in between $\angle 1$ and $\angle 3$. Also interiors of $\angle 1$ and $\angle 3$ do not overlap. Since the pair of angles does not satisfy one among the three conditions they are not adjacent.

Think

In each of the following figures, observe the pair of angles that are marked as $\angle 1$ and $\angle 2$. Do you think that they are adjacent pairs? Justify your answer.



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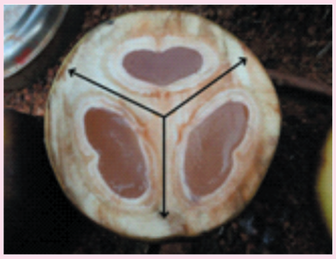
Try these

1. Few real life examples depicting adjacent angles are shown below.

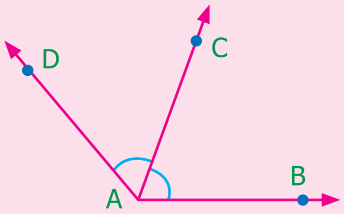


Can you give three more examples of adjecent angles seen in real life?

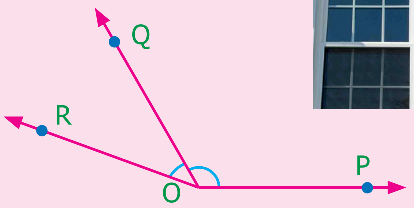
2. Observe the six angles marked in the picture shown (Fig 5.2). Write any four pairs of adjacent angles and that are not.

3. Identify the common arm, common vertex of the adjacent angles and shade the interior with two colours in each of the following figures.

(i)

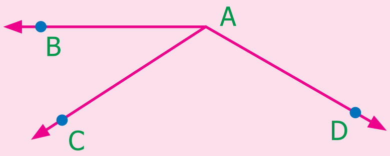


(ii)

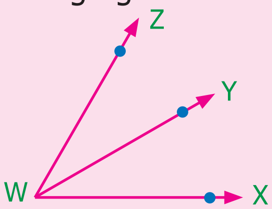


4. Name the adjacent angles in each of the following figure.

(i)



(ii)



5.2.2 Linear pair

Observe the Fig.5.3 $\angle QPR$ and $\angle RPS$ are adjacent angles. It is clear that $\angle QPR$ and $\angle RPS$ together will make $\angle QPS$ which is acute. When $\angle QPR$ and $\angle RPS$ are increased $\angle QPS$ becomes (i) right angle, (ii) obtuse angle, (iii) straight angle and (iv) reflex angle as shown in Fig.5.4.

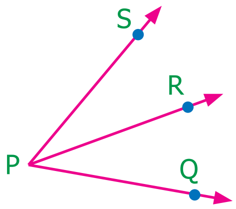


Fig.5.3

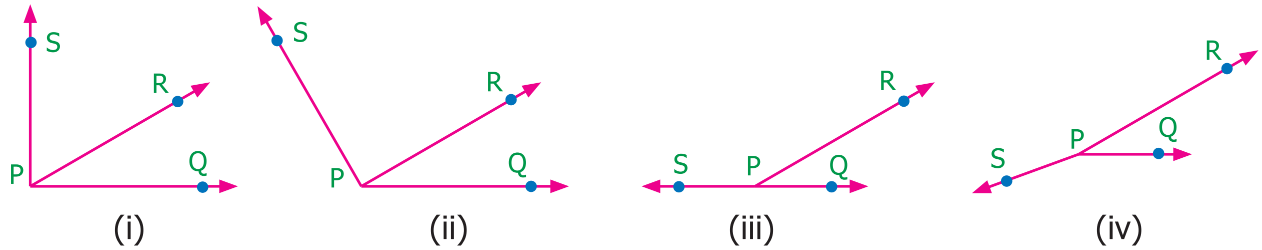


Fig.5.4

If the resultant angle is a straight angle then the angles are called supplementary angles. The adjacent angles that are supplementary lead us to a pair of angles that lie on straight line (Fig.5.4(iii)). This pair of angles are called linear pair of angles.

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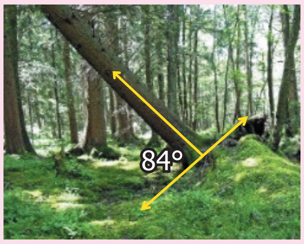
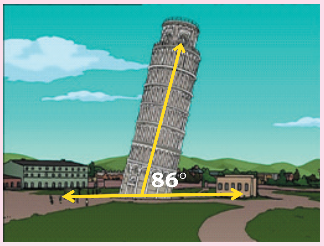
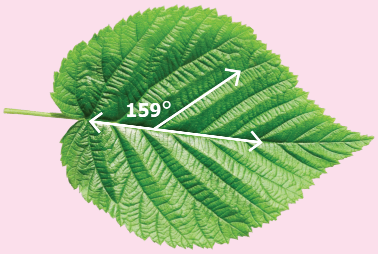
Try these

1. Observe the following pictures and find the other angle of linear pair.

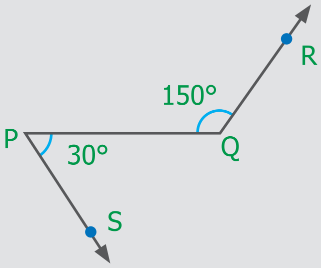






Think

Observe the figure. There are two angles namely $\angle PQR$ = 150° and $\angle QPS$ = 30°. Is all this pair of supplementary angles a linear pair? Discuss.



Example 5.1 In Fig. 5.5, find $\angle AOC$.

Solution

$\angle AOC$ = $\angle AOB + \angle BOC$

= 51° + 46°

= 97°

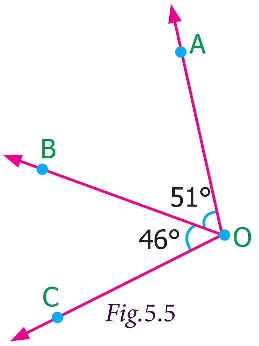


Fig.5.5

Example 5.2 If $\angle POQ$ = 23° and $\angle POR$ = 62° then find $\angle QOR$

Solution

We know that $\angle POR$ = $\angle POQ + \angle QOR$

62° = 23° + $\angle QOR$

Subtracting 23° on both sides

62° – 23° = 23° + $\angle QOR$ – 23°

$\angle QOR$ = 39°

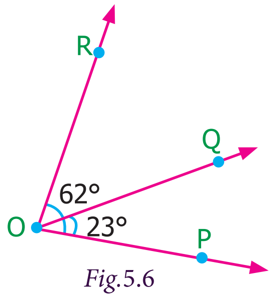


Fig.5.6

Example 5.3 Which of the following pair of adjacent angles will make a linear pair?

(i) 89°, 91° (ii) 105°, 65° (iii) 117°, 62° (iv) 40°, 140°

Solution

(i) Since 89° + 91° = 180°, this pair will be a linear pair.

(ii) Since 105° + 65° = 170° ≠ 180°, this pair cannot make a linear pair.

(iii) Since 117° + 62° = 179° ≠ 180°, this pair cannot make a linear pair.

(iv) Since 40° + 140° = 180°, this pair will be a linear pair.

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Example 5.4 Find the missing angle.

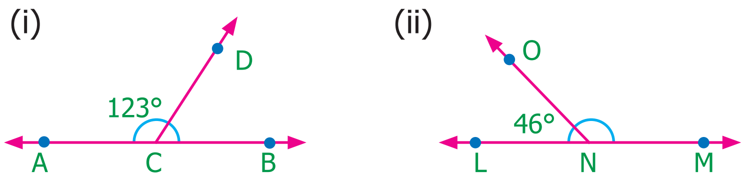

Fig.5.7

Solution

(i) Since the angles are linear pair, $\angle ACD + \angle BCD = 180°$

$123° + \angle BCD = 180°$

Subtracting 123° on both sides

$123° + \angle BCD - 123° = 180° - 123°$

$\angle BCD = 57°$

(ii) Since the angles are linear pair, $\angle LNO + \angle MNO = 180°$

$46° + \angle MNO = 180°$

Subtracting 46° on both sides

$46° + \angle MNO - 46° = 180° - 46°$

$\angle MNO = 134°$

Example 5.5 Two angles are in the ratio 3:2. If they are linear pair, find them.

Solution

Let the angles be $3x$ and $2x$

Since they are linear pair of angles, their sum is 180°.

Therefore, $3x+2x = 180°$

$5x = 180°$

$x = \frac{180°}{5}$

$x = 36°$

The angles are $3x = 3\times36 = 108°$

$2x = 2\times36 = 72°$

More on linear pairs

Amudhan asked his teacher what would happen if he drew a ray in between a linear pair of angles? The teacher told him to draw it. Amudhan drew the ray as shown in Fig.5.8.

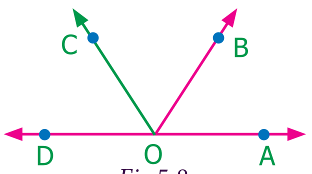

Fig.5.8

Teacher asked Amudhan, "what can you say about the angles $\angle AOB$ and $\angle BOC$?". He said that they are adjacent angles. Also it is true that $\angle AOB + \angle BOC = \angle AOC$.

The teacher also asked about the pair of angles $\angle AOC$ and $\angle COD$. He replied that they are linear pair. Therefore, their sum is 180° i.e. $\angle AOC + \angle COD = 180°$.

Combining these two results we get $\angle AOB + \angle BOC + \angle COD = 180°$.

Thus, the sum of all the angles formed at a point on a straight line is 180°.

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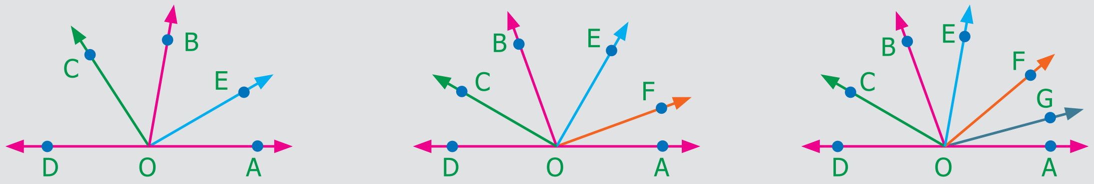
Think

What would happen to the angles if we add 3 or 4 or 5 rays on a line as given below?



We can learn one more result on linear pairs.
Observe the following Fig.5.9.
AB is a straight line. OC is a ray meeting AB at O.
Here, $\angle AOC$ and $\angle BOC$ are linear pair.
Hence $\angle AOC + \angle BOC = 180°$
Also, OD is another ray meeting AB at O.
Again $\angle AOD$ and $\angle BOD$ are linear pair.
Hence $\angle AOD + \angle BOD = 180°$
Now, $\angle AOC$, $\angle BOC$, $\angle AOD$ and $\angle BOD$ are the angles that are formed at the point O.
We can observe that $(\angle AOC + \angle BOC) + (\angle AOD + \angle BOD) = 180° + 180° = 360°$.
So, the sum of all angles at a point is 360°.

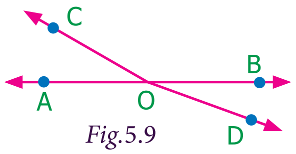
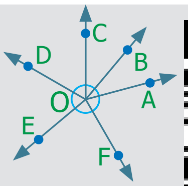


Fig.5.9

Think

Can you justify the following statement.

$\angle AOB + \angle BOC + \angle COD + \angle DOE + \angle EOF + \angle FOA = 360°$?



Example 5.6 From Fig.5.10, find the measure of $\angle ROS$.

Solution

We know that $\angle QOR + \angle ROS + \angle SOP = 180°$

$26° + \angle ROS + 32° = 180°$

$\angle ROS + 58° = 180°$

Subtracting 58° on both sides

We get, $\angle ROS = 180° - 58° = 122°$

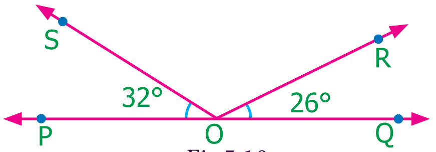


Fig.5.10

Example 5.7 In Fig. 5.11, find the value of $x°$

Solution

$98° + 23° + 76° + x° = 360°$

$197° + x° = 360°$

$x° = 360° - 197° = 163°$

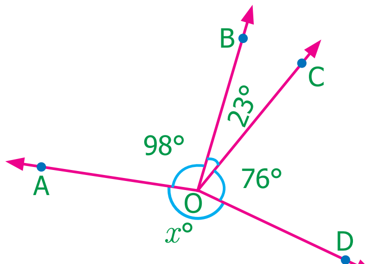


Fig.5.11

5.2.3 Vertically opposite angles

We have already studied about intersecting lines. Observe the Fig.5.12. There are two lines namely l and m which are intersecting at a point O and forming four angles at that point of intersection. They are $\angle 1$, $\angle 2$, $\angle 3$ and $\angle 4$.

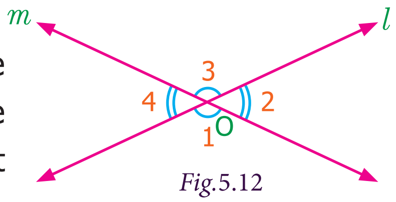


Fig.5.12

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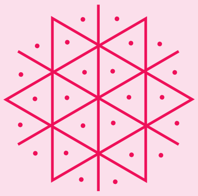
Consider any one angle among this say $\angle 1$. The angles which are adjacent to $\angle 1$ are $\angle 2$ and $\angle 4$, $\angle 3$ is a non-adjacent angle. Similarly, for the remaining three angles two angles will be adjacent and one angle will be non-adjacent. We can observe that an angle and its non-adjacent angle are just opposite to each other at the point of intersection O (vertex). Such angles which are opposite to each other with reference to the vertex are called vertically opposite angles.

When two lines intersect each other, two pairs of non-adjacent angles formed are called vertically opposite angles.

Try these

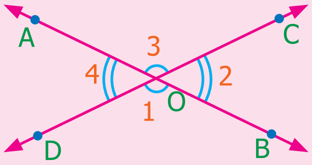
1. Four real life examples for vertically opposite angles are given below.



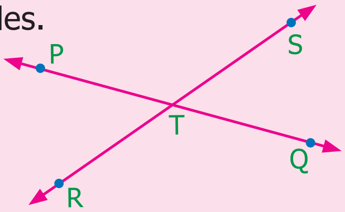
Give four more examples for vertically opposite angles in your surrounding.

2. In the given figure, two lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at O. Observe the pair of angles and complete the following table. One is done for you.

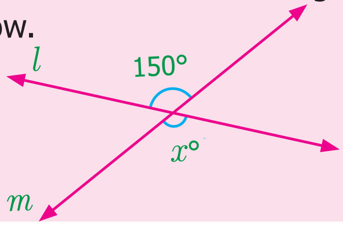
Pair of angles	$\angle AOC$	$\angle AOD$	$\angle BOC$	$\angle BOD$
$\angle AOC$	Same angle	Adjacent angle	Adjacent angle	Non – adjacent angle
$\angle AOD$				
$\angle BOC$				
$\angle BOD$				



3. Name the two pairs of vertically opposite angles.



4. Find the value of $x°$ in the figure given below.



Activity

On a paper draw two intersecting lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$. Let the two lines intersect at O. Label the two pairs of vertically opposite angles as $\angle 1$, $\angle 2$ and $\angle 3$, $\angle 4$. Make a trace of angles $\angle 2$ and $\angle 3$. Place the traced angle $\angle 2$ on angle $\angle 1$. Are they equal? Place the traced angle $\angle 3$ on angle $\angle 4$. Are they equal? Continue the same for five different pair of intersecting lines. Record your observations and discuss.

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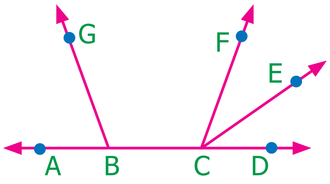
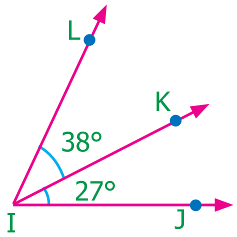
Exercise 5.1

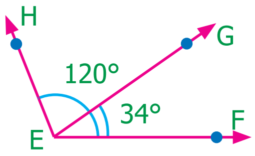
1. Name the pairs of adjacent angles.



2. Find the angle $\angle JIL$ from the given figure.

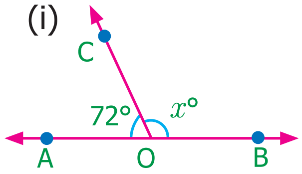


3. Find the angle $\angle GEH$ from the given figure.

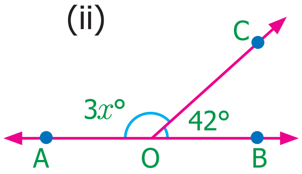


4. Given that AB is a straight line. Calculate the value of $x°$ in the following cases.

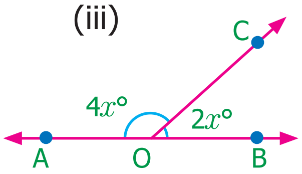
(i)



(ii)



(iii)



5. One angle of a linear pair is a right angle. What can you say about the other angle?

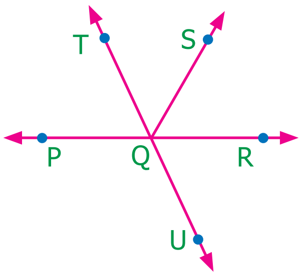
6. If the three angles at a point are in the ratio 1 : 4 : 7, find the value of each angle?

7. There are six angles at a point. One of them is 45° and the other five angles are all equal. What is the measure of all the five angles?

8. In the given figure, identify

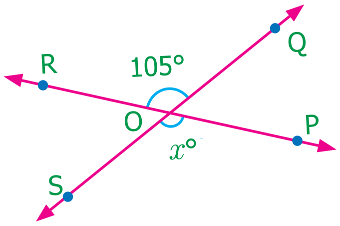
(i) any two pairs of adjacent angles.

(ii) two pairs of vertically opposite angles.

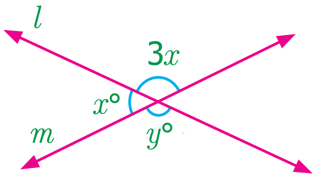


9. The angles at a point are $x°$, $2x°$, $3x°$, $4x°$ and $5x°$. Find the value of the largest angle?

10. From the given figure, find the missing angle.



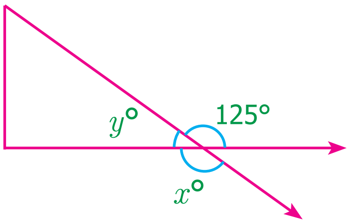
11. Find the angles $x°$ and $y°$ in the figure shown.



12. Using the figure, answer the following questions.

(i) What is the measure of angle $x°$?

(ii) What is the measure of angle $y°$?



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Objective type questions

13. Adjacent angles have

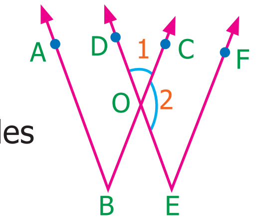
(i) no common interior, no common arm, no common vertex

(ii) one common vertex, one common arm, common interior

(iii) one common arm, one common vertex, no common interior

(iv) one common arm, no common vertex, no common interior

14. In the given figure the angles $\angle 1$ and $\angle 2$ are



(i) opposite angles (ii) Adjacent angles

(iii) Linear pair (iv) Supplementary angles

15. Vertically opposite angles are

(i) not equal in measure (ii) complementary

(iii) supplementary (iv) equal in measure

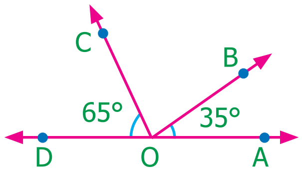
16. The sum of all angles at a point is

(i) 360° (ii) 180° (iii) 90° (iv) 0°

17. The measure of $\angle BOC$ is

(i) 90° (ii) 180°

(iii) 80° (iv) 100°



5.3 Transversal

Observe the Fig.5.13. Here m and n are any two non-parallel lines and l is another line intersecting them at A and B respectively. We call such intersecting line (l) as transversal. Therefore, a transversal is a line that intersects two lines at distinct points. We can extend this idea to any number of lines.

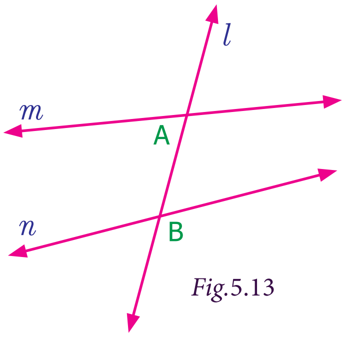


Fig.5.13

Now observe the following Fig.5.14. Check whether the line l is transversal to other line in both the cases (i) and (ii).

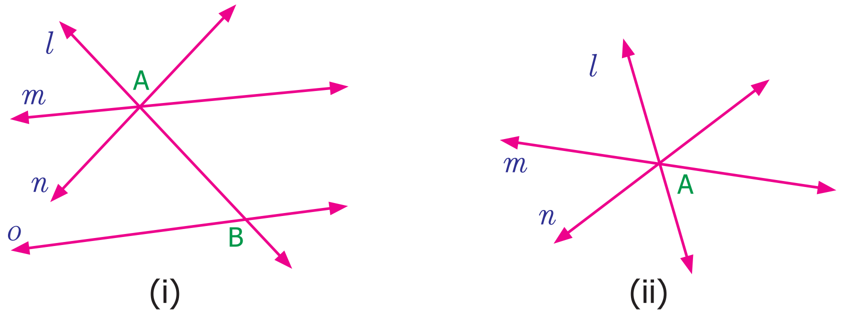


Fig.5.14

Think

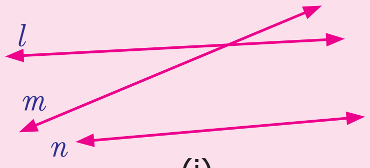
For a given set of lines, is it possible to draw more than one transversal?

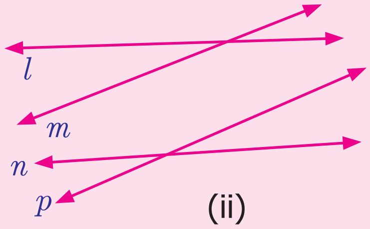
In figure (i) the line l is not a transversal to the lines m and n, but it is a transversal to the pair of lines m and o , n and o.

In figure (ii) l does not intersect the lines m and n at distinct points. So, it is not a transversal.

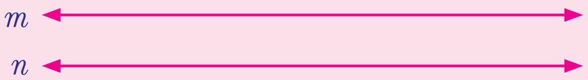
Try these

1. Draw as many possible transversals in the given figures.





2. Draw a line which is not the transversal to the above figures.
3. How many transversals can you draw for the following two lines?



5.3.1. Angles formed by a transversal

If a transversal meet two lines, eight angles are formed at the points of intersection as shown in the Fig.5.15.

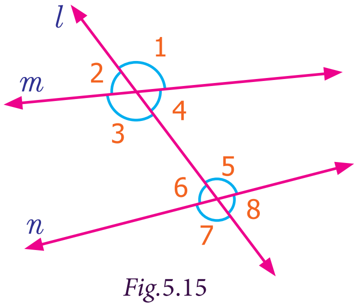


*Fig.*5.15

It is clear that the pairs of angles ∠1, ∠2, ; ∠3, ∠4, ; ∠5, ∠6 and ∠7, ∠8 are linear pairs. Can you find more linear pairs of angles?

Besides, the pairs ∠1, ∠3 ; ∠2, ∠4 ; ∠5, ∠7 and ∠6, ∠8 are vertically opposite angles.

We can further classify the angles shown in the Fig. 5.15 into different categories as follows.

Corresponding angles

Observe that the pair of angles ∠1 and ∠5 that are marked at the right side of the transversal l. In that ∠1 lies above the line m and ∠5 lies above the line n.

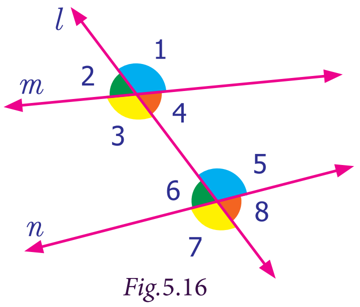


*Fig.*5.16

Also observe the pair of angles ∠2 and ∠6 that are marked on the left of the transversal l. In that ∠2 lies above m and ∠6 lies above n.

In the same way observe the pair of angles ∠3 and ∠7 that are marked on left of transversal l. In that ∠3 lies below m and ∠7 lies below n.

Observe the pair of angles ∠4 and ∠8 that are marked on the right of transversal l. In that ∠4 lies below m and ∠8 lies below n.

So all these pairs of angles have different vertices, lie on the same side (left or right) of the transversal(l), lie above or below the lines m and n. Such pairs are called corresponding angles.

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Alternate Interior angles

Each of pair of angles named ∠3 and ∠5, ∠4 and ∠6 are marked on the opposite side of the transversal l and are lying between lines m and n are called alternate interior angles.

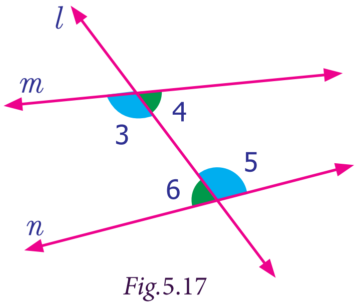

*Fig.*5.17

Alternate Exterior angles

Each pair of angles named ∠1 and ∠7, ∠2 and ∠8 are marked on the opposite side of the transversal l and are lying outside of the lines m and n are called alternate exterior angles.

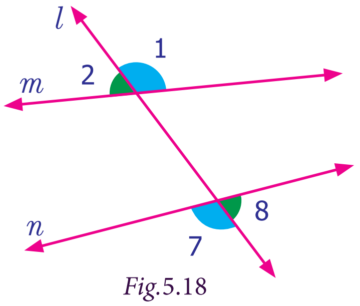

*Fig.*5.18

Now let us observe some more pairs of angles.

Each pair of angles named ∠3 and ∠6, ∠4 and ∠5 are marked on the same side of transversal l and are lying between the lines m and n. These angles are lying on the interior of the lines m and n as well as the same side of the transversal l.

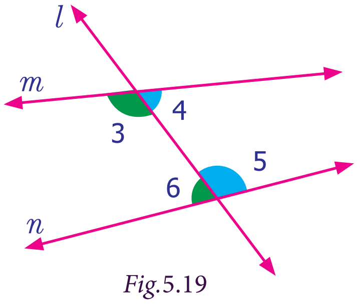

*Fig.*5.19

Each pair of angles named ∠1 and ∠8, ∠2 and ∠7 are marked on the same side of transversal l and are lying outside of the lines m and n. These angles are lying on the exterior of the lines m and n as well as the same side of the transversal l.

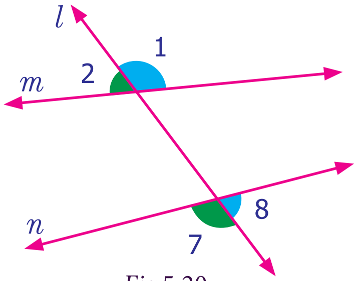

*Fig.*5.20

How can we call such angles?

We call them as co-interior and co-exterior angles.

DO YOU KNOW?

In Architecture, corresponding angles are used to assure symmetry and balance when designing the structure. Alternate exterior angles are used to ensure symmetry in floor plans. Alternate interior Angles are used to ensure that two beams are parallel and do not let the structure bend or deform in any form.

Interior angles on the same side of the transversal are used to determine if two beams are parallel and will not result in any distractions to the overall design. Exterior angles on the same side of the transversal are used to confirm that the walls are indeed straight and not at a different angle.

5.3.2 Angles formed by a transversal with Parallel lines

We saw different types of angles formed by a transversal while intersecting two given lines. Now let us observe some interesting facts on the angles formed by a transversal with the parallel lines from the following activities.

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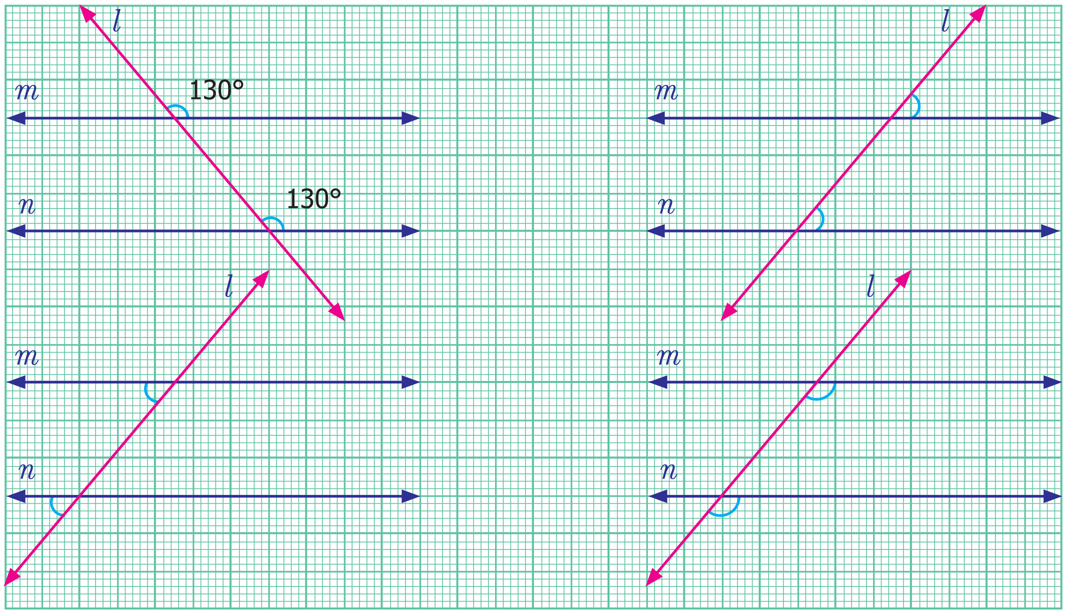
Activity

Observe the marked pair of corresponding angles in each figure. One in the interior and other in the exterior of the parallel lines and both lie on the same side of the transversal. One pair of angles are measured and found equal. Measure the remaining three pairs of angles and check.



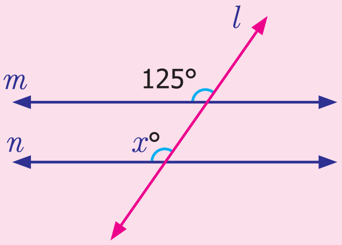
From the above activity, we can conclude that when two parallel lines are cut by a transversal, each pair of corresponding angles are equal.

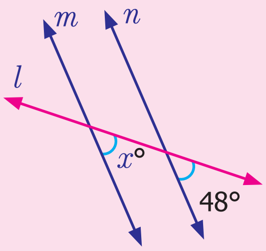
Try these

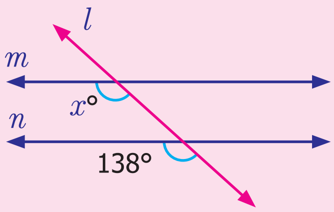
1. Four real life examples for transversal of parallel lines are given below.

Give four more examples for transversal of parallel lines seen in your surroundings.

2. Find the value of x .







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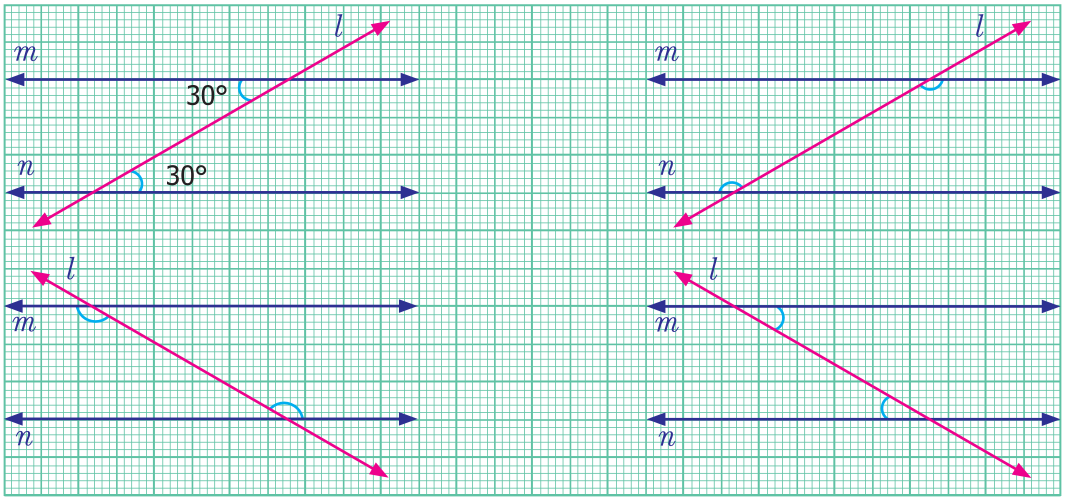
Activity

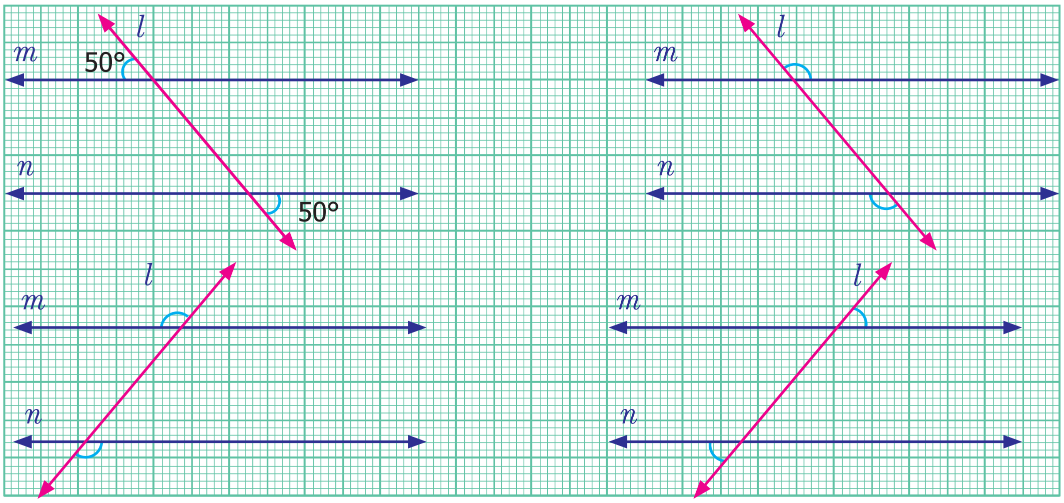
Observe the alternate Interior angles in each figure. Both lying between the interior of the parallel lines and on the opposite sides of the transversal. One pair of angles are measured and found equal. Measure the remaining three pairs of angles and check.



From the above activity we can conclude that when two parallel lines are cut by a transversal, each pair of alternate interior angles are equal.

Activity

Observe the marked alternate Exterior angles in each figure. Both lying at the exterior of the parallel lines and on the opposite sides of the transversal. One pair of angles are measured and found equal. Measure the remaining three pairs of angles and check.



From the above activity we can conclude that when two parallel lines are cut by a transversal, each pair of alternate exterior angles are equal.

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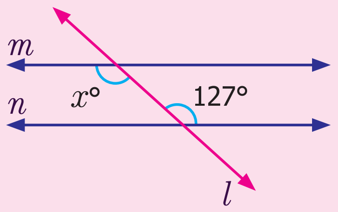
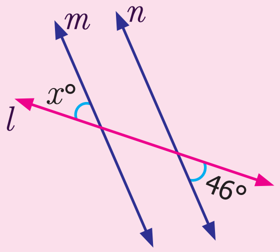
Try these

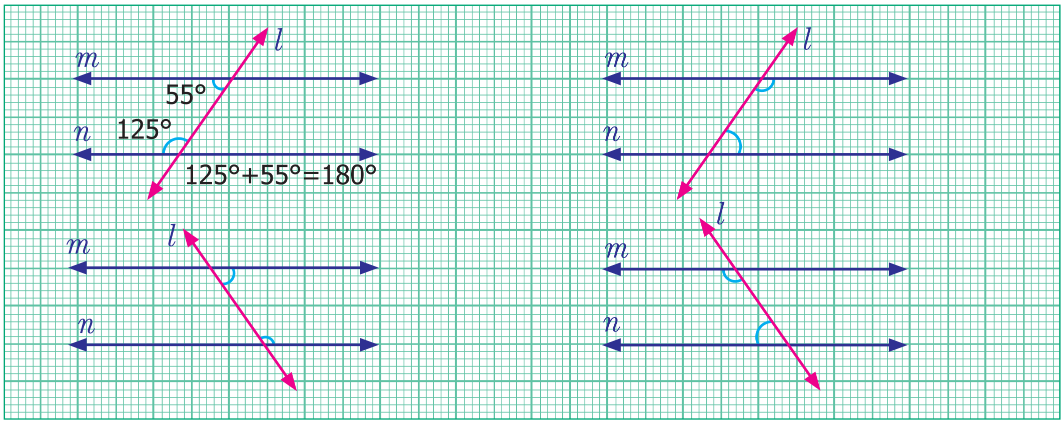
Find the value of $x°$.





Activity

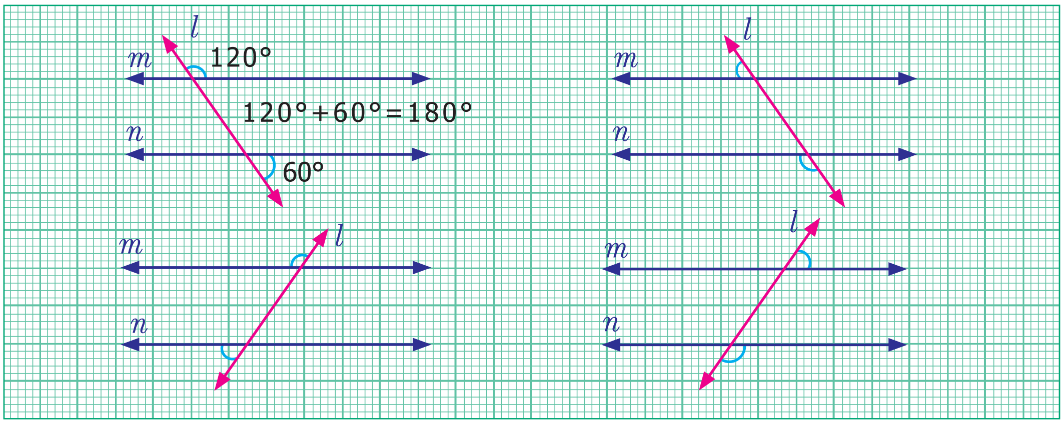
Observe the marked co-interior angles in each figure. Both lying between the interior of the parallel lines and on the same side of the transversal. One pair of angles are measured and found the sum to be 180°. Measure the remaining three pairs of angles and check.



From the above activity we can conclude that when two parallel lines are cut by a transversal, each pair of interior angles that lie on the same side of the transversal are supplementary.

Activity

Observe the marked co-exterior angles in each figure. Both lying at the exterior of the parallel lines and on the same side of the transversal. One pair of angles are measured and found that they are supplementary. Measure the remaining three pairs of angles and check.



From the above activity we can conclude that when two parallel lines are cut by a transversal, each pair of exterior angles that lie on the same side of the transversal are supplementary.

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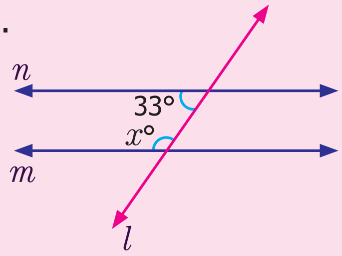
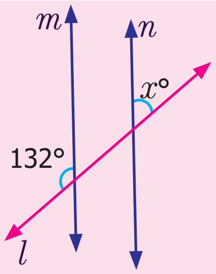
Try these

Find the value of x .





Example 5.8

(i) Name the angle that corresponds to $\angle 1$.

(ii) Name the angle that is alternate interior to $\angle 3$.

(iii) Name the angle that is alternate exterior to $\angle 8$.

(iv) Name the angle that corresponds to $\angle 8$.

(v) Name the angle that is alternate exterior to $\angle 7$.

(vi) Name the angle that is alternate interior to $\angle 6$.

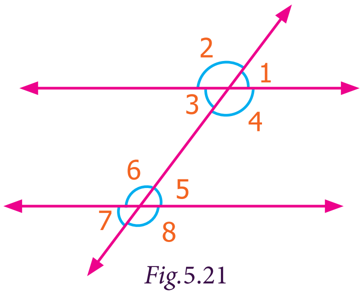


Fig.5.21

Solution

(i) The angle that corresponds to $\angle 1$ is $\angle 5$

(ii) The angle that is alternate interior to $\angle 3$ is $\angle 5$

(iii) The angle that is alternate exterior to $\angle 8$ is $\angle 2$

(iv) The angle that corresponds to $\angle 8$ is $\angle 4$

(v) The angle that is alternate exterior to $\angle 7$ is $\angle 1$

(vi) The angle that is alternate interior to $\angle 6$ is $\angle 4$

Example 5.9

(i) Which angles are corresponding angles to b°?

(ii) What is the measure of b°?

(iii) Which angles have the measure 68°?

(iv) Which angles have the measure 112°?

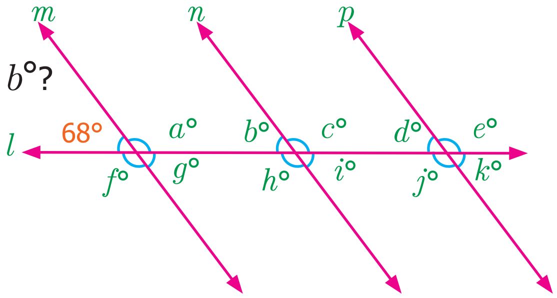


Fig.5.22

Solution

(i) The corresponding angles to b° are d° and 68°.

(ii) The measure of b° is 68° (Because b° corresponds to 68°)

(iii) The angles having measure 68° are b°, d°, g°, i° and k°.

(iv) The angles having measure 112° are a°, c°, e°, f°, h° and j°.

Example 5.10 If l is parallel to m, find the measure of x and y in the figure.

Solution Given l is parallel to m and n is transversal to l and m.

We get, $y = 2x$ [Vertically opposite angles are equal]

$y + 4x = 180°$ [sum of interior angles that lie on the same side of the transversal]

$2x + 4x = 180°$ [since $y = 2x$]

$6x = 180°$

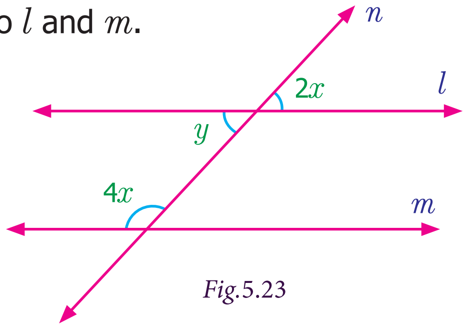


Fig.5.23

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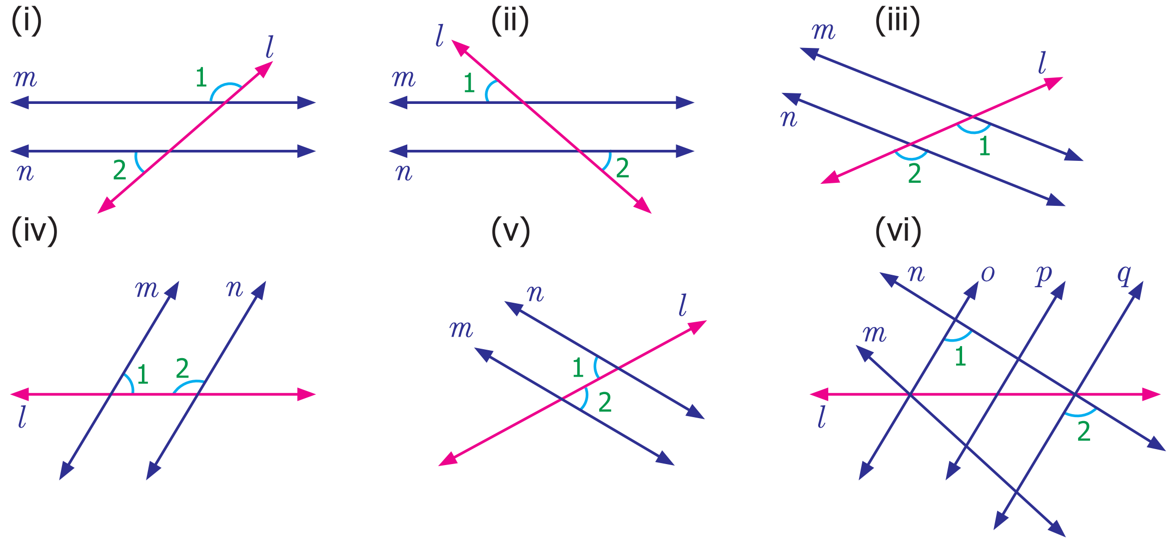
Dividing by 6 on both sides

$\frac{x}{6} = \frac{180^\circ}{6}$ gives, $x = 30°$.

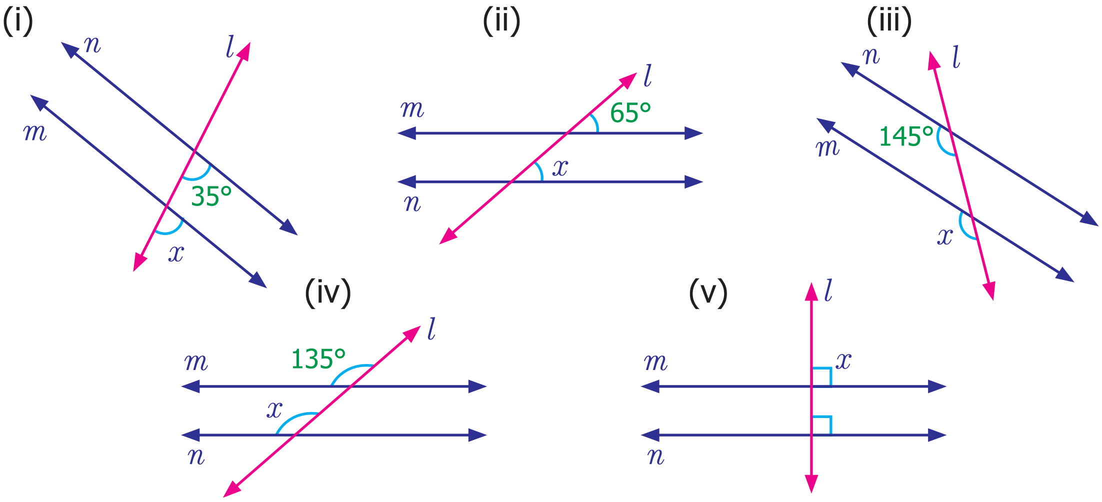
Now, $y = 2(30°) = 60°$.

Exercise 5.2

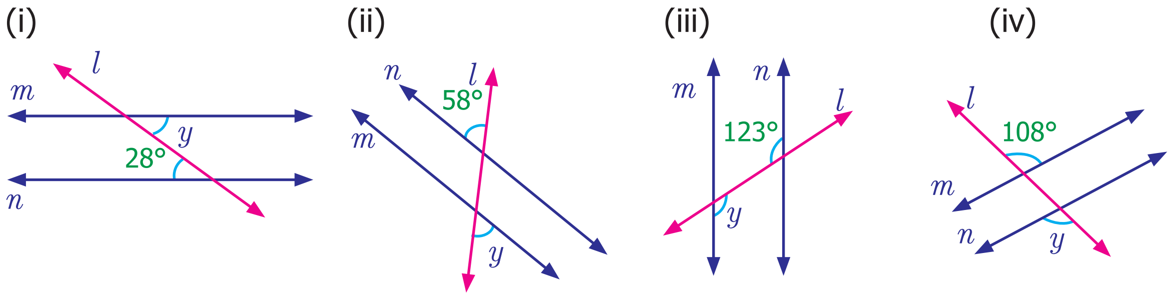
1. From the figures name the marked pair of angles.



2. Find the measure of angle x in each of the following figures.



3. Find the measure of angle y in each of the following figures.



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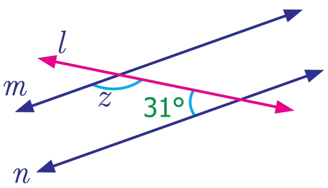
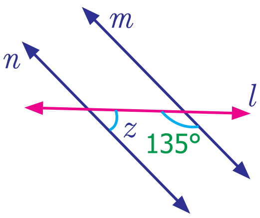
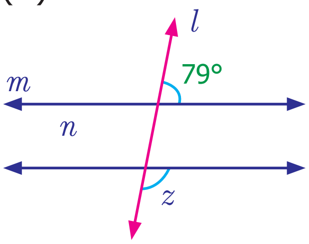
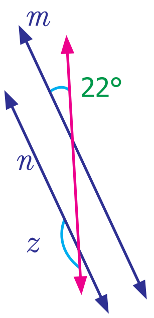
4. Find the measure of angle z in each of the following figures.

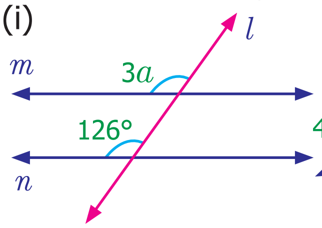
(i)


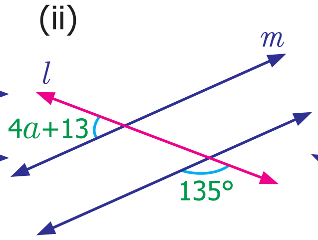
(ii)


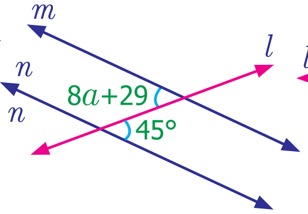
(iii)


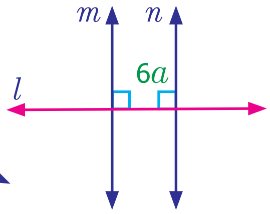
(iv)


5. Find the value of angle a in each of the following figures.

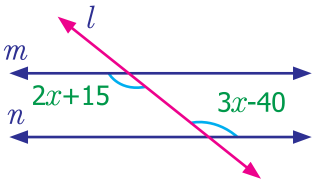
(i)


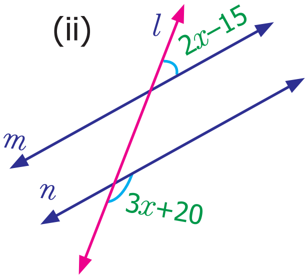
(ii)


(iii)


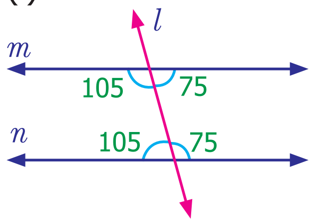
(iv)


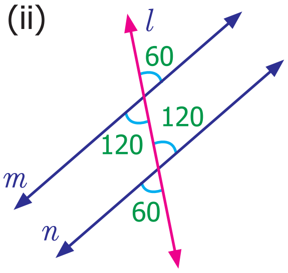
6. Find the value of angle x in both the figures.

(i)


(ii)


7. Anbu has marked the angles as shown below in (i) and (ii). Check whether both of them are correct. Give reasons.

(i)


(ii)


8. Mention two real-life situations where we use parallel lines.

9. Two parallel lines are intersected by a transversal. What is the minimum number of angles you need to know to find the remaining angles. Give reasons.

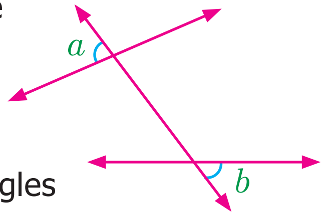
Objective type questions

10. A line which intersects two or more lines in different points is known as

(i) parallel lines (ii) transversal

(iii) non-parallel lines (iv) intersecting line

11. In the given figure, angles a and b are



(i) alternate exterior angles (ii) corresponding angles

(iii) alternate interior angles (iv) vertically opposite angles

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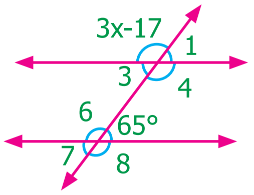
12. Which of the following statements is ALWAYS TRUE when parallel lines are cut by a transversal
   (i) corresponding angles are supplementary.
   (ii) alternate interior angles are supplementary.
   (iii) alternate exterior angles are supplementary.
   (iv) interior angles on the same side of the transversal are supplementary.

13. In the diagram, what is the value of angle x?



   (i) 43° (ii) 44°
   (iii) 132° (iv) 134°

5.4 Construction

In geometry, construction means to draw lines, angles and shapes accurately. In earlier class we learnt to draw a line segment, parallel and perpendicular line to the given line segment and an angle using protractor.

Now we are going to learn to construct, perpendicular bisector of a given line segment, angle bisector of a given angle and angles 60°, 30°, 120°, 90°,45° without using protractor.

All the figures shown are not to scale.

5.4.1 Construction of perpendicular bisector of a line segment

In earlier class, we learnt about perpendicular lines. Observe the Fig.5.24.

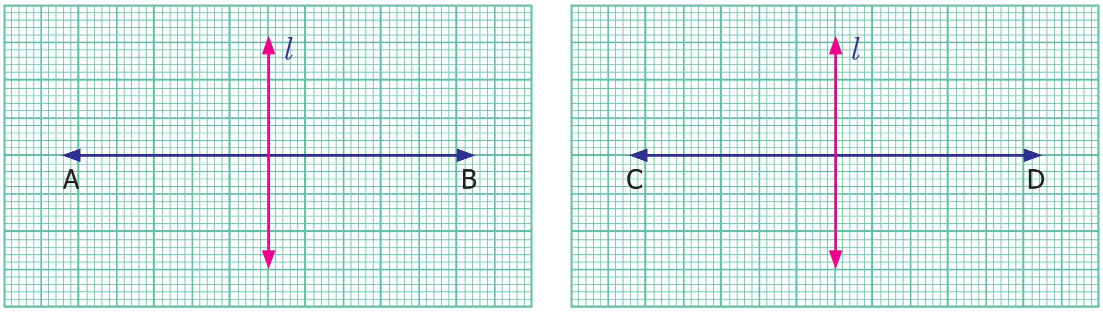


Fig.5.24

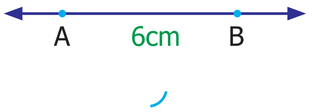
These are perpendicular lines. In both the cases the perpendicular line l divides both the line segments into two equal parts. This line is called perpendicular bisector of the line segment. So, a perpendicular line which divides a line segment into two equal parts is a perpendicular bisector of the given line segment.

Now we are going to learn, how to construct a perpendicular bisector to a given line segment.

Example 5.11 Construct a perpendicular bisector of the line segment AB = 6 cm.

Step 1: Draw a line. Mark two points A and B on it so that AB = 6 cm.

Step 2: Using compass with A as center and radius more than half of the length of AB, draw two arcs of same length, one above AB and one below AB.



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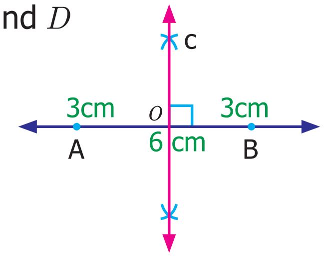
Step 3: With the same radius and B as center draw two arcs to cut the arcs drawn in step 2. Mark the points of intersection of the arcs as C and D

Step 4: Join C and D. CD will intersect AB. Mark the point of intersection as O

CD is the required perpendicular bisector of AB.

Measure $\angle AOC$. Measure the length of AO and OB. What do you observe?



Think

1. What will happen if the radius of the arc is less than half of AB?

Exercise 5.3

1. Draw a line segment of given length and construct a perpendicular bisector to each line segment using scale and compass.

   (a) 8 cm (b) 7cm (c) 5.6 cm (d) 10.4 cm (e) 58 mm

5.4.2 Construction of angle bisector of an angle.

If a line or line segment divides an angle into two equal angles, then the line or line segment is called angle bisector of the given angle.

In the following figures we can observe some angle bisectors.

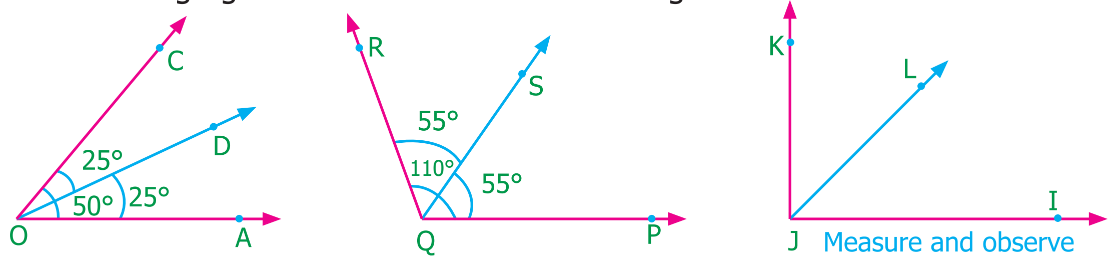


Fig.5.25

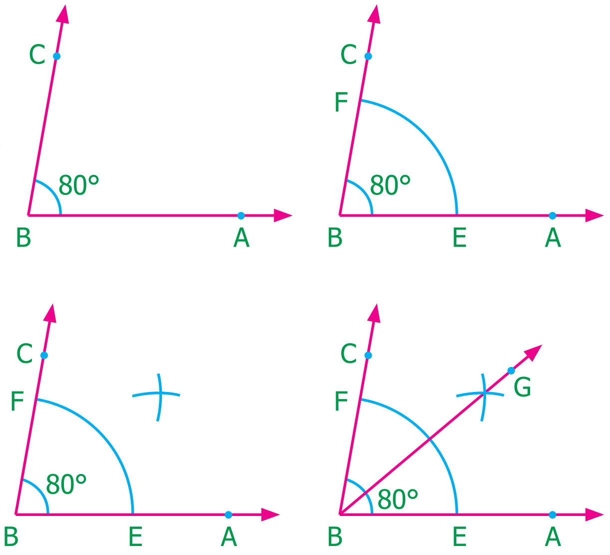
Example 5.12 Construct bisector of the $\angle ABC$ with the measure 80°.

Step 1: Draw the given angle $\angle ABC$ with the measure 80° using protractor.

Step 2: With B as center and convenient radius, draw an arc to cut BA and BC. Mark the points of intersection as E on BA and F on BC.

Step 3: With the same radius and E as center, draw an arc in the interior of $\angle ABC$ and another arc of same measure with center at F to cut the previous arc.

Step 4: Mark the point of intersection as G. Draw a ray BX through G.



BG is the required bisector of the given angle $\angle ABC$

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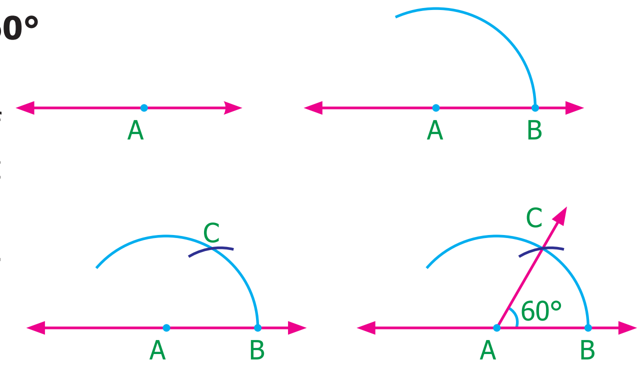
Exercise 5.4

1. Construct the following angles using protractor and draw a bisector to each of the angle using ruler and compass.
   (a) 60° (b) 100° (c) 90° (d) 48° (e) 110°

5.4.3 Construction of special angles without using protractor.

(i) Construction of angle of measure 60°



Step 1: Draw a line. Mark a point A on it.

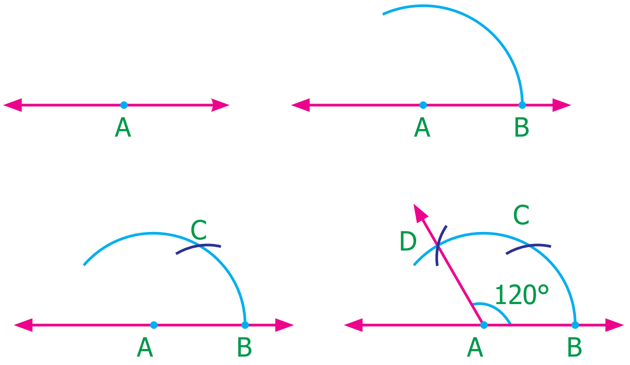
Step 2: With A as center draw an arc of convenient radius to the line to meet at a point B.

Step 3: With the same radius and B as center draw an arc to cut the previous arc at C.

Step 4: Join AC. Then $\angle BAC$ is the required angle with the measure 60°.

(ii) Construction of angle of measure 120°.

We know that there are two 60° agnels in 120°. Hence, to construct 120°, we can construct two 60° angles consecutively as follows.



Step 1: Draw a line. Mark a point A on it.

Step 2: With A as center, draw an arc of convenient radius to the line at a point B.

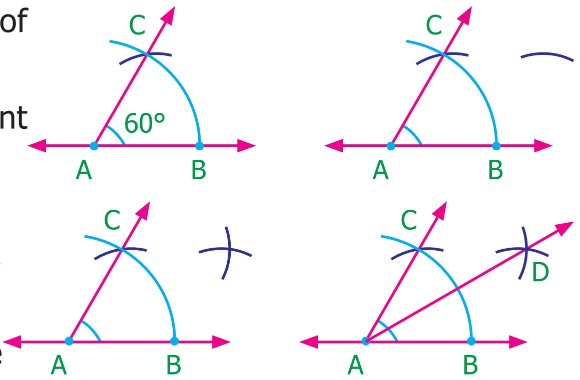
Step 3: With the same radius and B as center, draw an arc to cut the previous arc at C.

Step 4: With the same radius and C as center, draw an arc to cut the arc drawn in step 2 at D.

Step 5: Join AD. Then $\angle BAD$ is the required angle with measure 120°.

(iii) Construction of angle of measure 30°

Since 30° is half of 60°, we can construct 30° by bisecting the angle 60°.



Step 1: Construct angle 60° [Refer Construction of angle of measure 60° (i)].

Step 2: With B as center, draw an arc of convenient radius in the interior of $\angle BAC$.

Step 3: With the same radius and C as center, draw an arc to cut the previous arc at D.

Step 4: Join AD. Then $\angle BAD$ is the required angle with measure 30° [Think about $\angle DAC$?]

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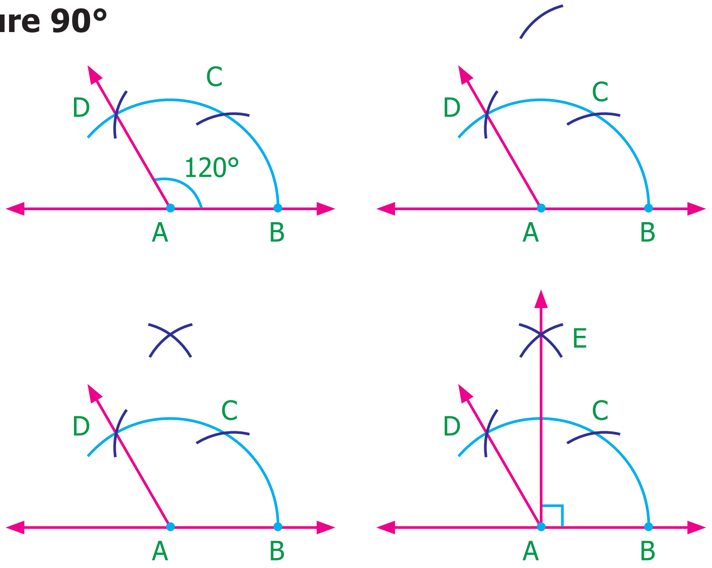
(iv) Construction of angle of measure 90°

Step 1: Construct angle 120° [Refer Construction of angle of measure 120° (ii)].

Step 2: With C as center, draw an arc of convenient radius in the interior of $\angle CAD$.

Step 3: With the same radius and D as center, draw an arc to cut drawn in step 3 at E.

Step 4: Join AE. Then $\angle BAD$ = 90° is the required angle



Exercise 5.5

1. Construct the following angles using ruler and compass only.

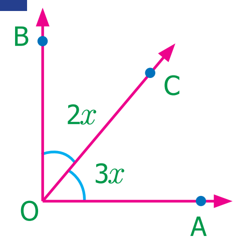
   (i) 60°   (ii) 120°   (iii) 30°   (iv) 90°

   (v) 45°   (vi) 150°   (vii) 135°

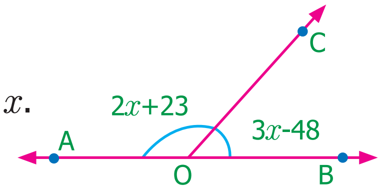
Exercise 5.6

Miscellaneous Practice problems

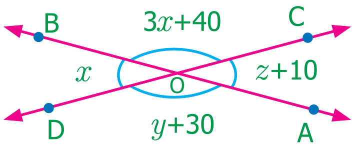
1. Find the value of x if $\angle AOB$ is a right angle.



2. In the given figure, find the value of x.



3. Find the value of x, y and z



4. Two angles are in the ratio 11: 25. If they are linear pair, find the angles.

5. Using the figure, answer the following questions and justify your answer.

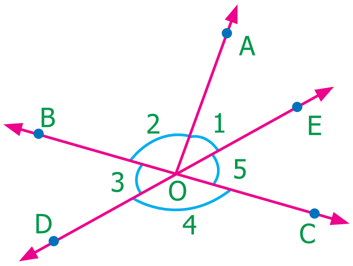
   (i) Is $\angle 1$ adjacent to $\angle 2$?

   (ii) Is $\angle AOB$ adjacent to $\angle BOE$?

   (iii) Does $\angle BOC$ and $\angle BOD$ form a linear pair?

   (iv) Are the angles $\angle COD$ and $\angle BOD$ supplementary?

   (v) Is $\angle 3$ vertically opposite to $\angle 1$?



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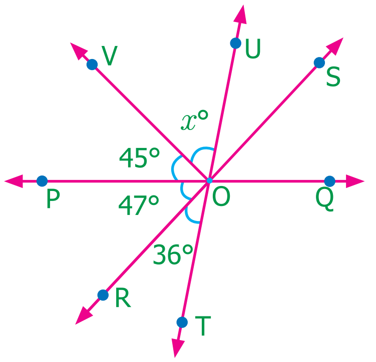
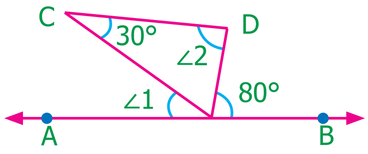
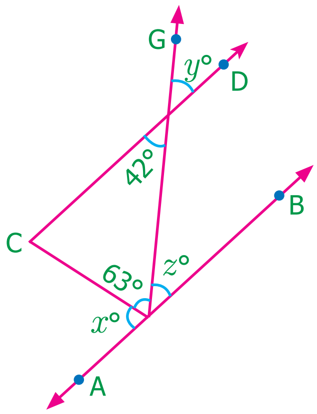
6. In the figure POQ, ROS and TOU are straight lines. Find the $x°$.



7. In the figure AB is parallel to DC. Find the value of $\angle 1$ and $\angle 2$. Justify your answer.

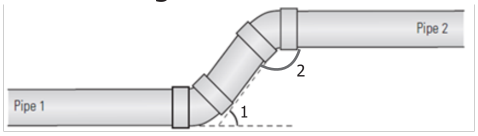


8. In the figure AB is parallel to CD. Find x,y and z.



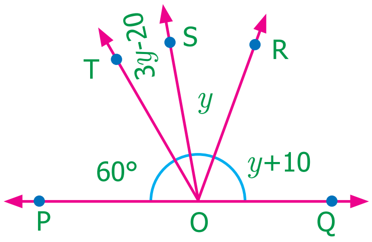
9. Draw two parallel lines and a transversal. Mark two alternate interior angles G and H. If they are supplementary, what is the measure of each angle?

10. A plumber must install pipe 2 parallel to pipe 1. He knows that $\angle 1$ is 53. What is the measure of $\angle 2$?

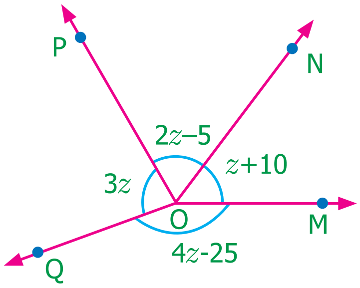


Challenge Problems

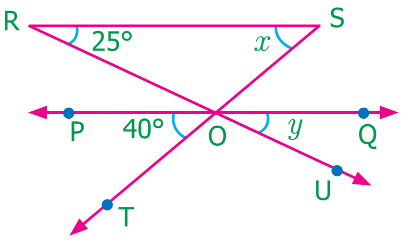
11. Find the value of y.



12. Find the value of z.

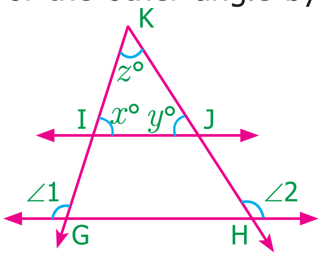


13. Find the value of x and y if RS is parallel to PQ.

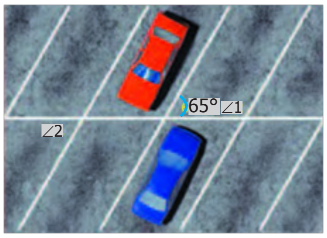


14. Two parallel lines are cut by a transversal. For each pair of interior angles on the same side of the transversal, if one angle exceeds the twice of the other angle by 48°. Find the angles.

15. In the figure, the lines GH and IJ are parallel. If $\angle 1$=108° and $\angle 2$ = 123°, find the value of x, y and z.



16. In the parking lot shown, the lines that mark the width of each space are parallel. If $\angle 1$ = $(x+39)°$, $\angle 2$ = $(2x–3y)°$, find x and y.



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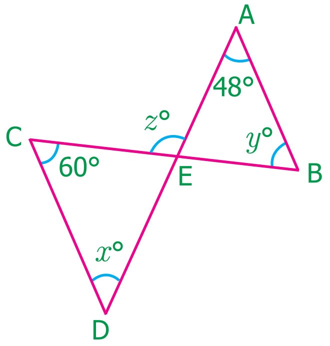
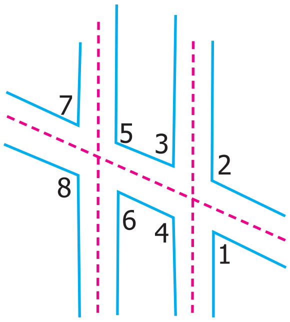
17. Draw two parallel lines and a transversal. Mark two corresponding angles A and B. If $\angle A = 4x$ and $\angle B = 3x + 7$, find the value of x. Explain..

18. In the figure AB is parallel to CD. Find x°, y° and z°.



19. Two parallel lines are cut by a transversal. If one angle of a pair of corresponding angles can be represented by 42° less than three times the other. Find the corresponding angles.

20. In the given figure, $\angle 8 = 107^\circ$, what is the sum of the $\angle 2$ and $\angle 4$?



S83ZG

Summary

- Two angles which have a common vertex and a common arm, whose interiors do not overlap are called adjacent angles.
- The adjacent angles that are supplementary are called linear pair of angles.
- The sum of all the angles formed at a point on a straight line is 180°.
- The sum of the angles at a point is 360°.
- When two lines intersect each other, two pairs of non-adjacent angle formed are called vertically opposite angles.
- A transversal is a line that intersects two or more lines at distinct points.
- when two parallel lines are cut by a transversal,
  - ◇ each pair of corresponding angles are equal.
  - ◇ each pair of alternate Interior angles are equal.
  - ◇ each pair of alternate exterior angles are equal.
  - ◇ interior angles on the same side of the transversal are supplementary.
  - ◇ exterior angles on the same side of the transversal are supplementary.

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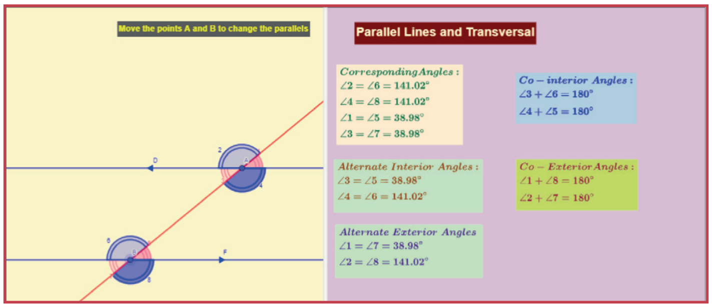
ICT Corner

Expected Result is shown in this picture

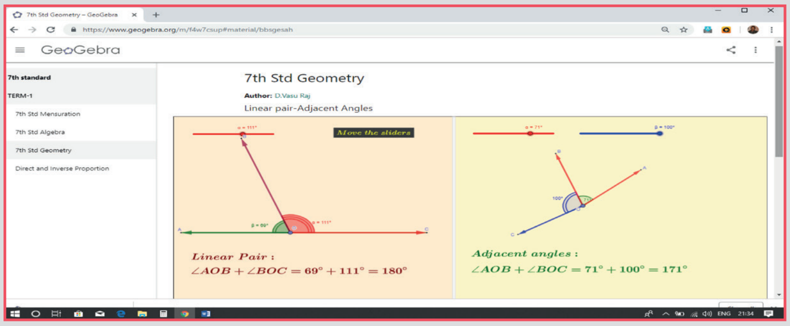


Step – 1 : Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "7th std Geometry" will open. There are two activities 1. Linear pair- Adjacent Angles, 2. Parallel lines and Transverse.

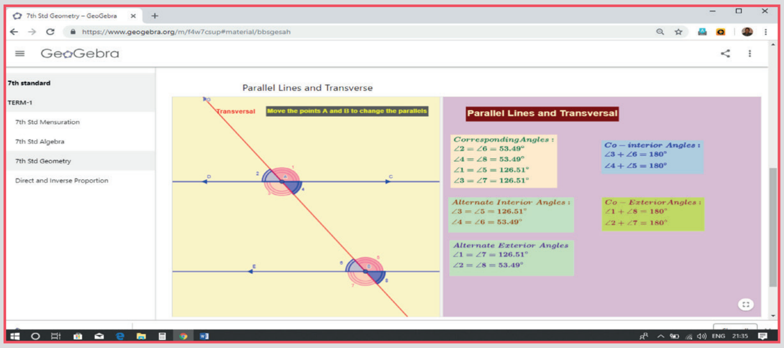
In the second activity "Parallel lines and Transverse" move the points A and B and observe the different angles formed by the transverse line.

Step - 2 : Move the sliders to get, Parallelogram or Rectangle or Square and see the points given and observe.

Step 1



Step 2



Browse in the link

Geometry: https://ggbm.at/bbsgesah
or Scan the QR Code.

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Chapter

6 INFORMATION PROCESSING

KTU26

Learning objectives

- To create larger shapes using Tetrominoes.
- To analyse visual information using route map.

Recap

The activities given below, help us to recall sorting and arranging information that we studied in class VI.

Activity

Create the shapes of birds shown below, using the tangram pieces (*Fig 6.1*) and paste it in the bird sanctuary picture (*Fig 6.2*). One is done for you.

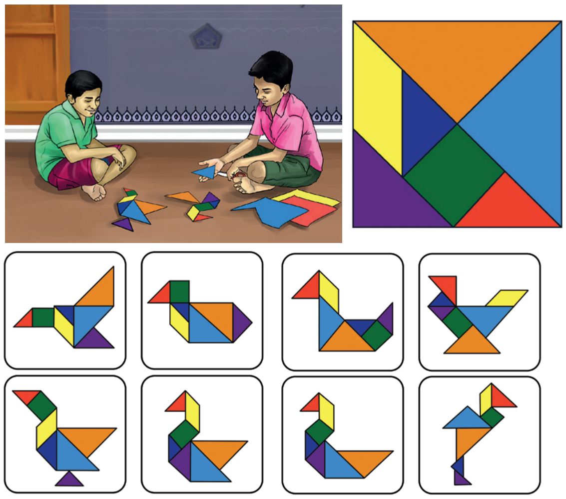


Fig 6.1

Fig 6.2

Activity

Calendar Math Puzzle

Discuss the properties of numbers circled in the shaded shape shown in the calender. Identify more such shapes.

AUGUST						2019
SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Fig 6.3

Activity

1. Complete the given sequence.

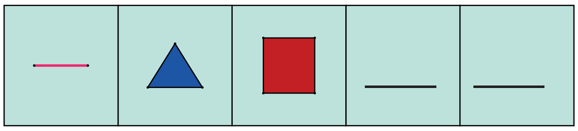
(i) 

Fig 6.4

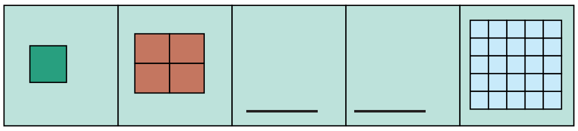
(ii) 

Fig 6.5

2. Find the number of all possible squares that can be formed from the Fig. 6.6.

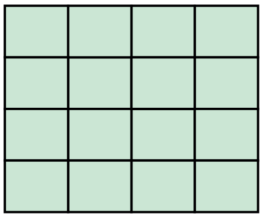
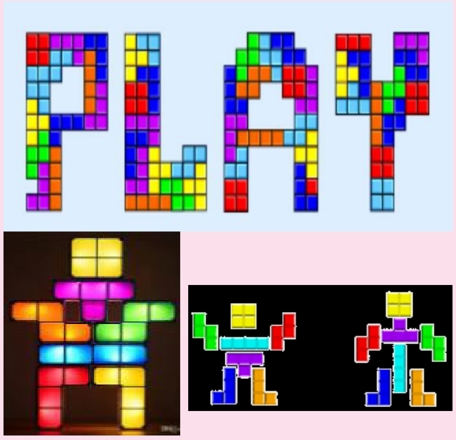


Fig 6.6

6.1 Introduction

In class VI we studied Sudoku which is a number puzzle. Now, we shall learn about ***"Tetromino".***

MATHEMATICS ALIVE – INFORMATION PROCESSING IN REAL LIFE

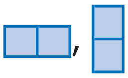


Creating shapes using Tertrominoes

Road routes

6.2 Tetromino

To know about tetromino, it is essential to have an idea about ***Domino and Trinomino.***

Join two squares of size 1cm x 1cm edge to edge. Such formation is called as ***Domino.*** When we arrange Domino either horizontally or vertically we get the following shapes ().

Similarly, when we join three squares along their edges we get the formation

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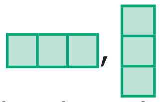
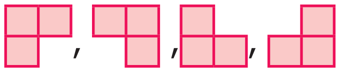
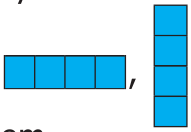
called ***Trinomino.*** When we arrange horizontally or vertically we get the following shapes ().

Is this the only way to join the three squares ? No, we get four different orientations of shape as shown ().

Try to join four squares either horizontally or vertically as we did for Domino and Trinomino, then we get the following shapes . Is there any other way of joining four squares. Yes, let us learn about them.

Situation 1

The teacher divide the students into five groups and gives each group 20 square (of size 1 cm x 1 cm) tokens. Then ask them to form different shapes using the four square tokens and compare the shapes created by all groups. Draw the common shapes on the blackboard.

How many shapes do we get ?

Only five shapes, isn't it?

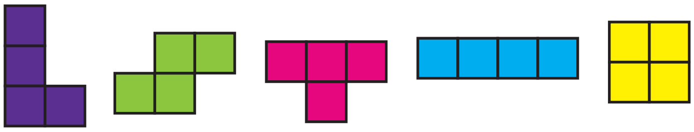


Fig 6.7

When we rotate these shapes, we get all the other shapes as shown below :

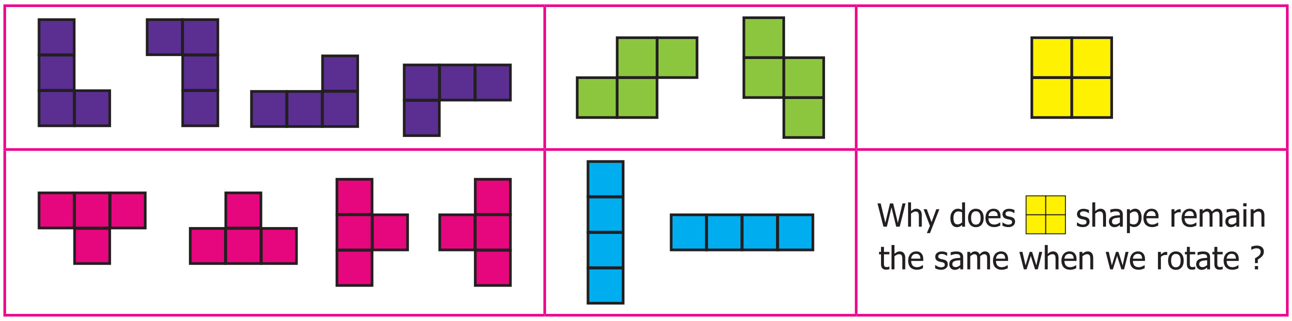


Fig 6.8

Thus, all the formation of four squares formed by joining edge to edge are called " *TETROMINOES* ".

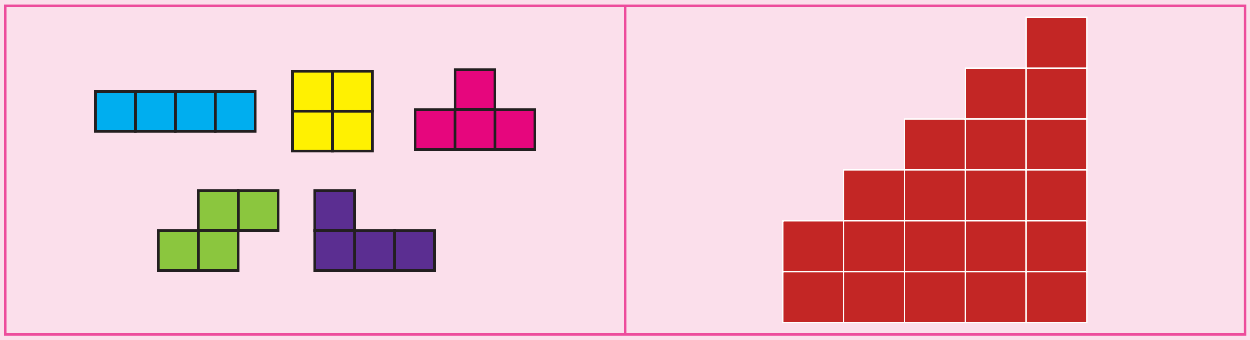
DO YOU KNOW?

The word " Tri" means three. Joining three squares is called "Trinomino".

The word " Tetra" means four. Joining four squares is called "Tetromino".

Try this

Use the given five tetrominoes only once and create the shape given below.



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6.2.1 Filling rectangular tiles using Tetrominoes

Situation 2

Can you form the rectangles of same area using the five tetrominoes only once? No, observe the following formations (*Fig 6.9 – 6.12*) where we have arranged tetrominoes edge to edge and tried to fill in rectangles. The boxes marked **X** are not filled by a tetromino. Hence the rectangle is incomplete. Also, some squares protrude outside the boundary of the rectangle.

The five tetrominoes together consist of 20 squares. Using 20 squares we can form the rectangles of size 1 x 20, 20 x 1, 2 x 10, 10 x 2, 4 x 5, and 5 x 4.

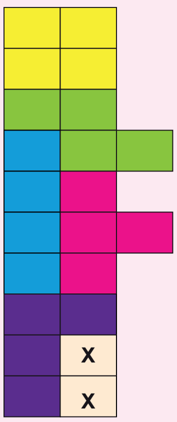


Fig 6.9

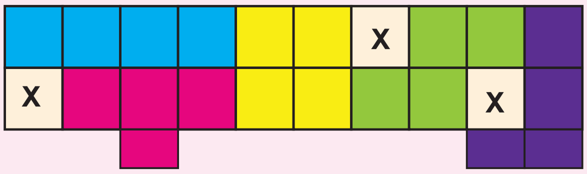


Fig 6.10

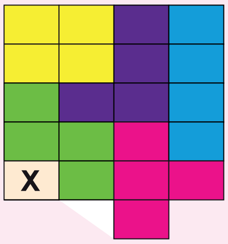


Fig 6.11

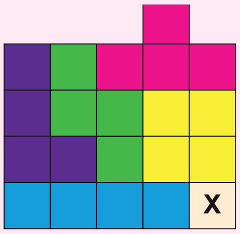


Fig 6.12

Why we are not able to form rectangular shapes using these tetrominoes only ones?. To know the reason, take the five tetrominoes in the form shown below.

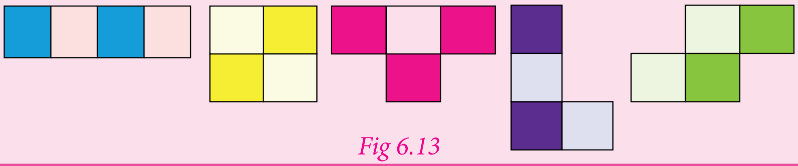
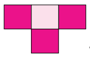


Fig 6.13

From among the five tetrominoes, in four of them, the number of shaded and unshaded squares are equal. But, in one tetromino , the shaded and unshaded squares are not equal. Hence, it is impossible to fit the tetrominoes in the rectangle using it only once.

However, If we use all the five tetrominoes twice, rectangles of sizes 5 x 8 , 4 x 10 and so on. It can be completely filled in, as shown in Fig. 6.14 and Fig.6.15.

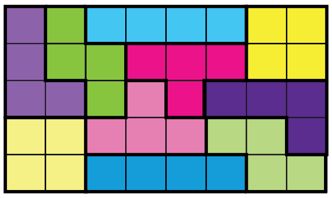


Fig 6.14

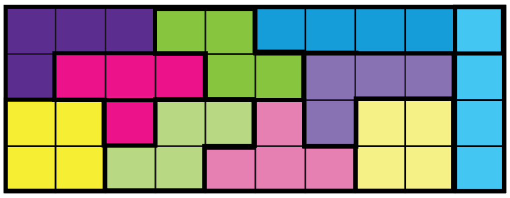


Fig 6.15

This concept will be useful in many places in real life situation like tiling a floor, packing things in a box and so on.

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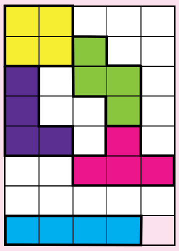
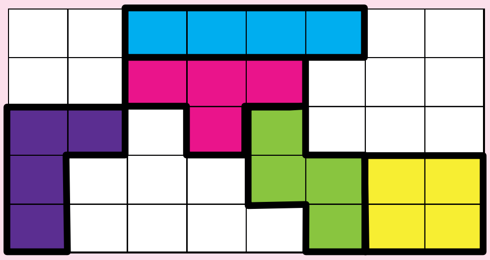
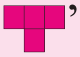
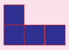
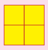
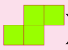
1. Complete the rectangles given below using the five tetrominoes only once.

(i)



(ii)



2. In Fig 6.16 one 4 x 4 square is filled by a tetromino shape ‘’. In the same way try to fill the other 4 x 4 square grids (Fig.6.17 to Fig.6.20) using the other four tetrominoes ( , ,  and ). Find which tetromino shape cannot fill the 4 x 4 square grid completely.

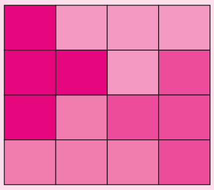


Fig 6.16

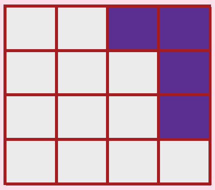


Fig 6.17

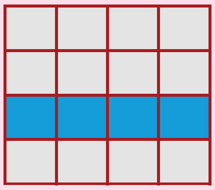


Fig 6.18

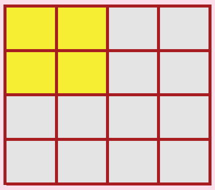


Fig 6.19

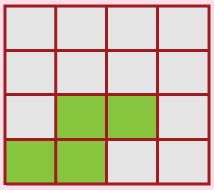


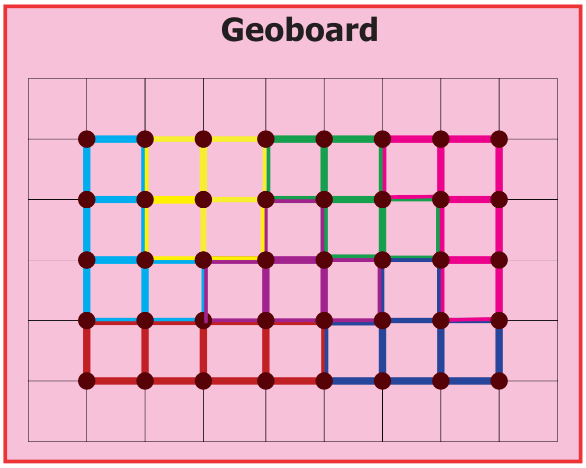
Fig 6.20

Example 6.1

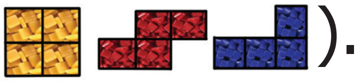
Find the tetromino shapes found in the showcase given in Fig.6.21 below. Form the same shape in the geoboard using rubberbands.

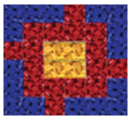
Fig 6.21

Solution



Example 6.2

Raghavan wants to change the front elevation of his house using the tiles made up of tetromino shapes ().

1. How many tetrominoes are there in a tile  ?

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2. If the cost of a square tile is ₹ 52 then what will be the cost of the tiles that Raghavan buys for the front elevation? (see Fig. 6.22)

Fig 6.22

Solution

1.

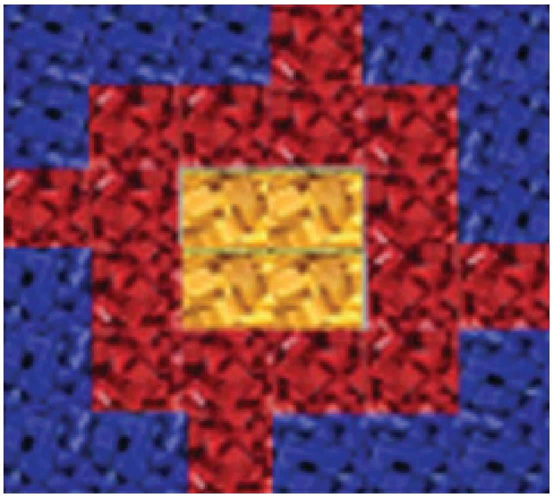

Fig 6.23

In one tile there are

= 1 tetromino

= 4 tetrominoes

= 4 tetrominoes

Therefore, there are nine tetrominoes in a tile.

2. Given, the cost of a tile is ₹ 52

There are six tiles in the front elevation

Therefore, the total cost = 6 × 52 = ₹ 312

Exercise 6.1

1. A tetromino is a shape obtained by .... squares together.
2. Draw a tetromino which passes symmetry ....

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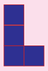
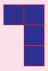
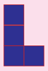
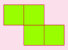
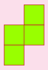
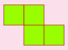
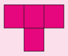
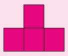
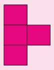
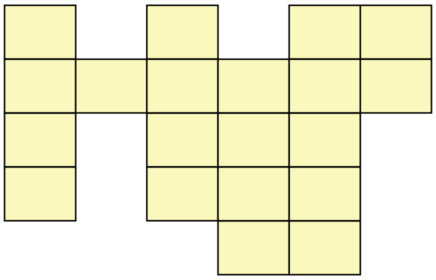
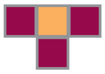
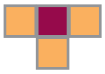
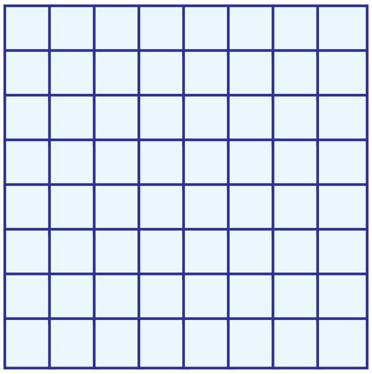
3. Complete the table

S.No.	Tetro Minoes	Rotation of Tetrominoes°			
		90°	180°	270°	360°
1				___	
2			___	___	
3		___			___

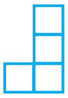
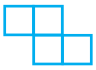
4. Shade the figure completely, by using five Tetromino shapes only once.

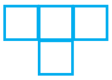


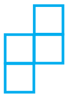
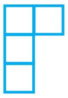
5. Using the given Tetromino shaded in two different ways ( ), fill the grid in such a way that, no two adjacent boxes have the same colour.

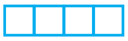
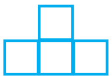


6. Match the tetrominoes of same type.

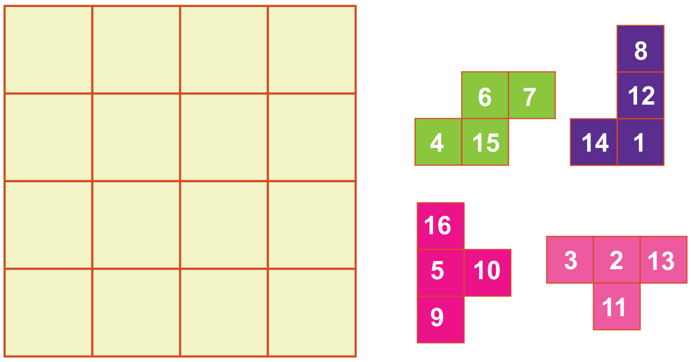
(i)  

(ii) 

(iii)  

(iv)  

7. Using the given tetrominoes with numbers, complete the 4 x 4 magic square .



6.3 ROUTE MAP

Situation 1

Maps are used to display a wide variety of information. Reading a map can help us to solve many problems in travel such as planning, for travel, place of visit. Let us, learn how to find the shortest possible route in a map.

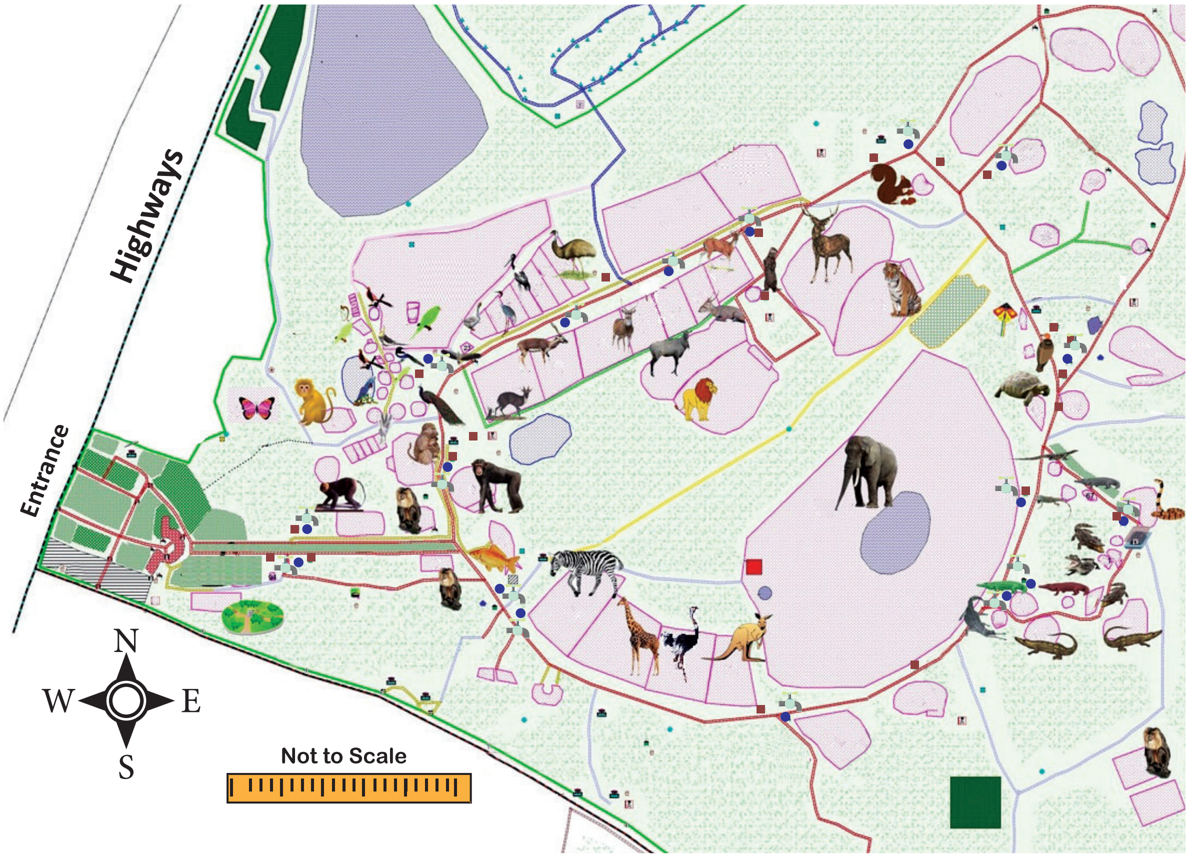


Fig.6.24

Answer the following questions using The Arignar Anna Zoological Park map :

1. To visit the chimpanzee area, from the entrance, one has to go straight and turn towards …………………….. (Left / Right)

2. Choose the right option among the following, which indicates the animals lying West and East of an Elephant.

   (i) Deer ← Elephant → Crocodile (ii) Tiger ← Elephant → Deer

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3. One can see giraffe only after seeing zebra. Is it true?

4. In the given map , list the names of 6 animals that are seen in the zoo

1.	....	2.	....	3.	....
4.	....	5.	....	6.	....

5. Mention any two animals that are seen in the south side of the zoo.
6. The entrance of the zoo is located at .... direction of the map.
7. List three animals located at eastern side of the map.

The above situation shows how the route map guides one to visit a new place.

Situation 2

This situation familiarizes one to read the road map. In the Fig.6.25 various places like school, park, house, hotel and so on are connected through roads.

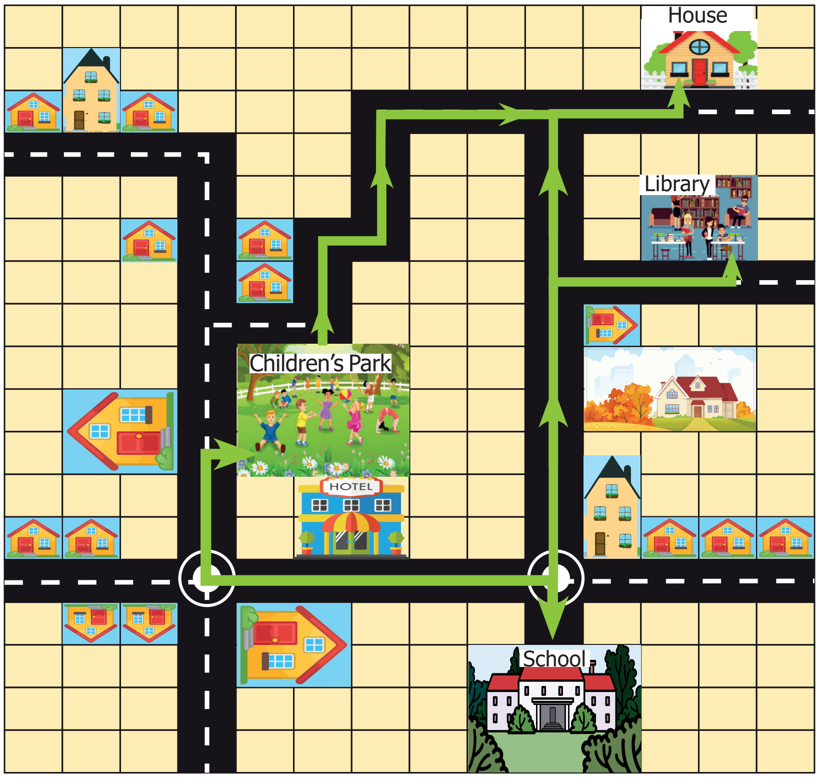

Fig 6.25 Scale : 1 unit ( ) = 100m

Find the distance using the scale.

1. Find the distance of the library from the house?
2. Find the distance that Chandru travels from school to his house via library?
3. Find the distances from the children's park to school and park to house. Which is the shortest distance?

Solution:

1. Library is at the distance of 10 units from the house.

   Therefore, $10 \times 100\ m = 1000\ m$ (1 unit = 100 m)

2. Distance from school to library is 11 units

   Therefore, $11 \times 100\ m = 1100\ m$ (1 unit = 100 m)

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Distance from library to house is 10 units

Therefore, $10 \times 100\ m = 1000\ m$ (1 unit = 100 m)

Therefore, Total distance travelled by Chandru = $1100+1000 = 2100\ m$

3. The distance from the children's park to school is 11 units

Therefore, $11 \times 100 = 1100\ m$ (1 unit = 100 m)

The distance from the children's park to house is 12 units

Therefore, $12 \times 100 = 1200\ m$ (1 unit = 100 m)

Therefore, Distance from the children's park to school is shorter than the other one.

DO YOU KNOW?

For the benefit of visitors, the Arignar Anna Zoological Park, Vandalur has introduced the live streaming on the whereabouts of animals in the web link *(https://www.aazp.in/live-streaming/)*

6.3.1 To find the "Shortest " route

Often, we face with situations where we have to decide the shortest way of travel from a certain point **A** to another point **B**.

A route map helps us to choose the way suitable for our purpose or need. Let us see some examples of how we select the shortest route.

Example 6.3

Madhan has to go to Karur from Coimbatore for an official visit. On his onward journey, he goes via Vellakoil to reach Karur. While returning to Coimbatore he travels via Erode. Both the routes travelled by him are given in the Fig. 6.26. Find the shortest route?

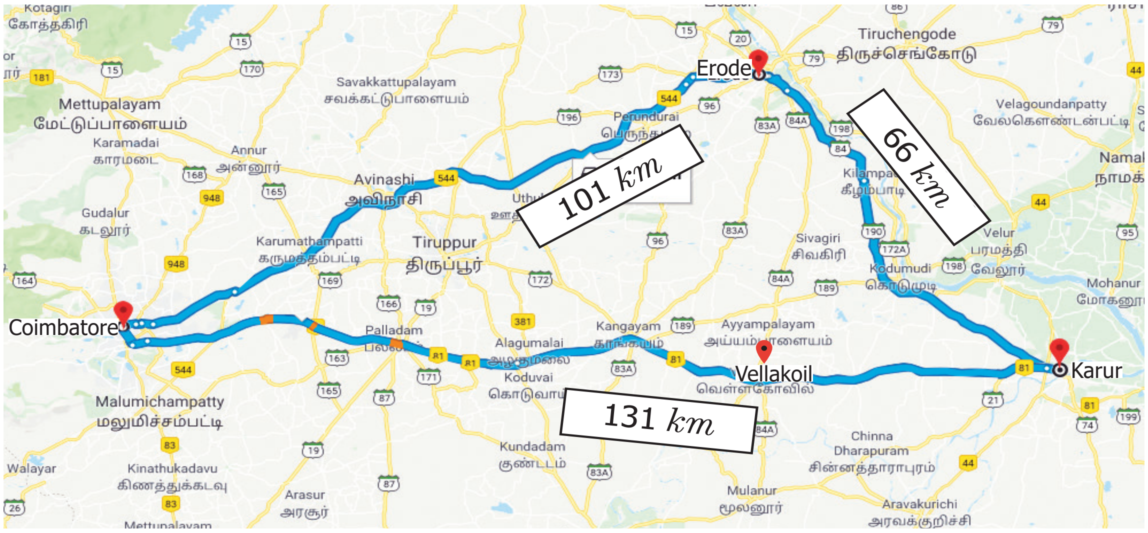

Fig 6.26

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Solution:

Distance travelled by Madhan from

Coimbatore to Karur via Vellakoil = 131 km

Distance travelled by Madhan from

Karur to Coimbatore via Erode = 66 + 101 = 167 km

Therefore, the route via Vellakoil is the shortest route.

Example 6.4

A telephone exchange worker wants to give the telephone connection to Amutha's house. Fig.6.27 shows all the possibilities of cable connections. Find the route which requires minimum cable?

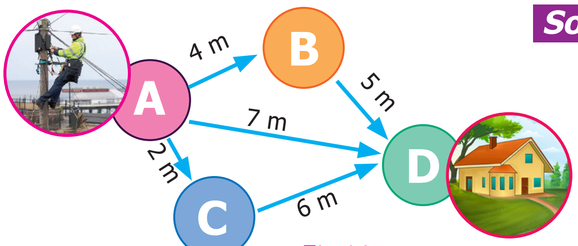


Fig 6.27

Solution

Distance from A to D = 7 m

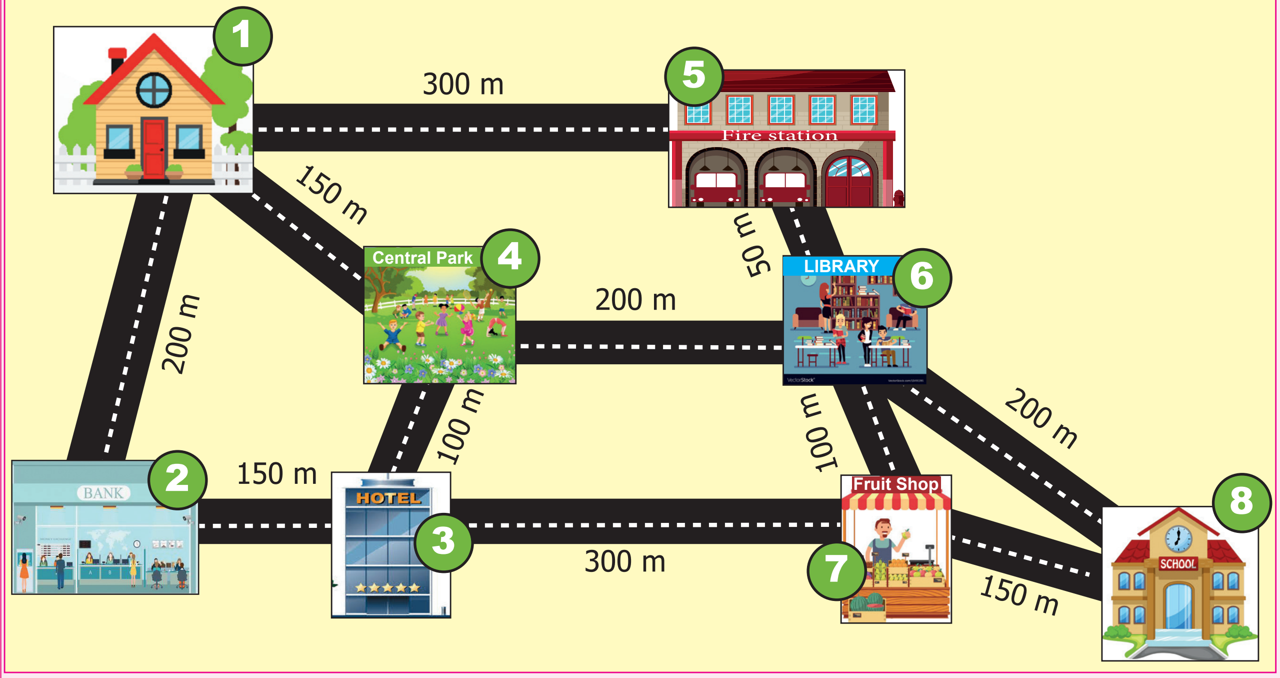
Distance from A to D (via B) = 4+5 = 9 m

Distance from A to D (via C) = 2+6 = 8 m

Therefore, the route directly from A to D requires minimum cable of length 7 m.

Try these

1. Observe the picture and answer the following



(i) Find all the possible routes from house to school via fire station

(ii) Find all the possible routes between central park and school with distance. Mention the shortest route?

(iii) Calculate the shortest distance between bank and school.

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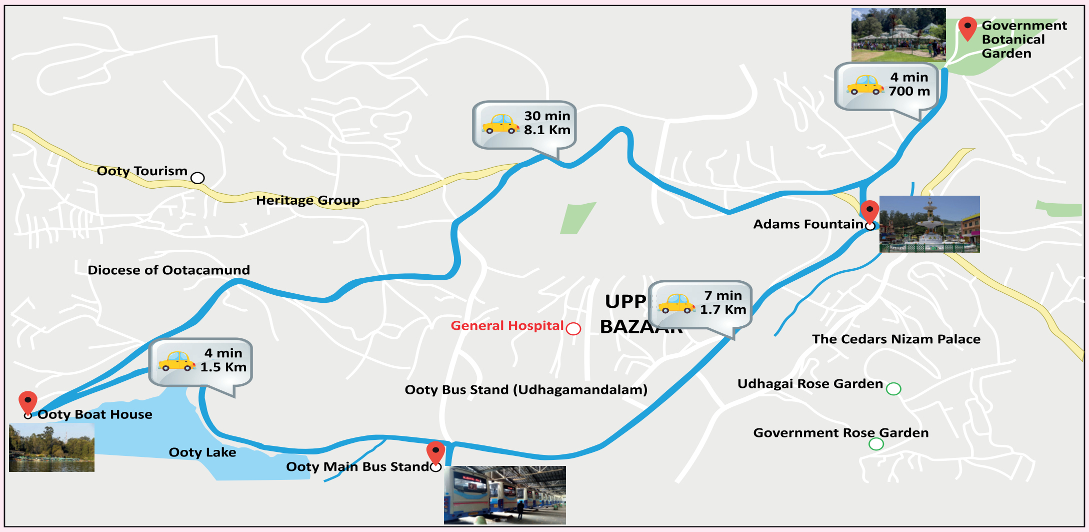
2. A school has planned for a trip to Ooty. Using the route map, the school decides to visit the places such as Boat House, Adam Founatian and Botanical Garden.



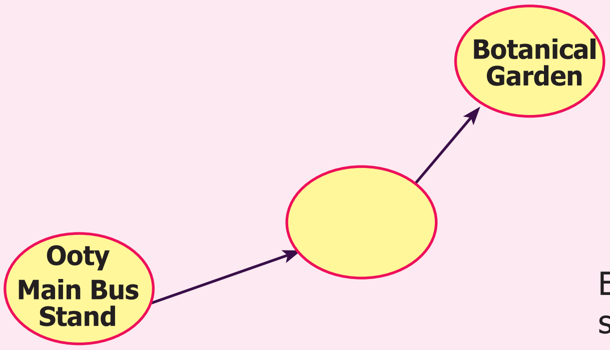
(i) How much distance you have to travel to Botanical Garden from Ooty Boat House?

(ii) Find the shortest route to Botanical from the Ooty Main Bus Stand.

(iii) Mention the direction of Botanical Garden from Adams Fountain.

(iv) In what direction, Ooty Boat House is situated from Ooty Main Bus Stand.

(v) Complete the following route map from Ooty Main Bus Stand to Botanical Garden.



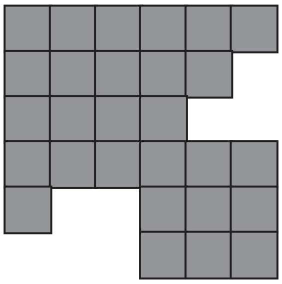
GPBX3

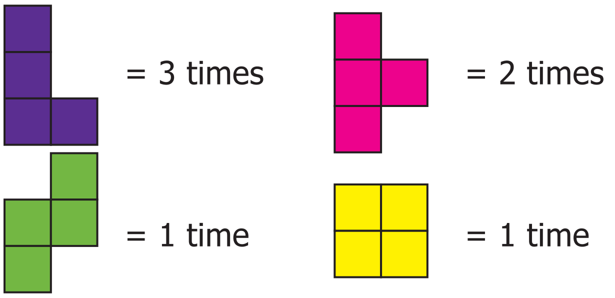
Encourage students to plan for a trip to some more places using map.

Exercise 6.2

Miscellaneous Practice problems

1. Make a model of a fish using the given tetromino shapes.





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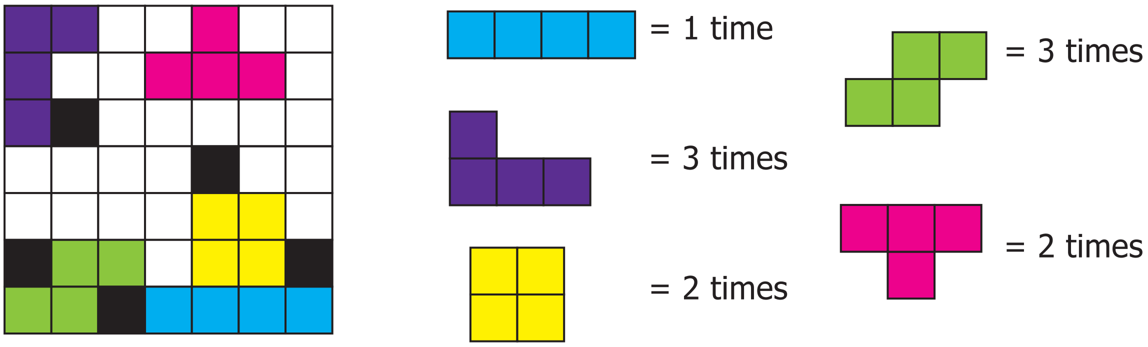
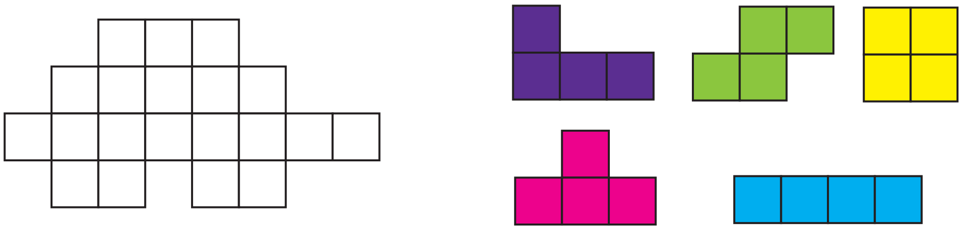
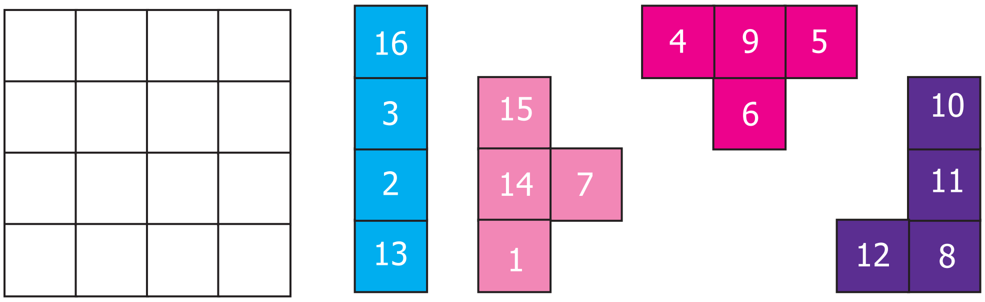
2. Complete the given rectangle using the given tetromino shapes.



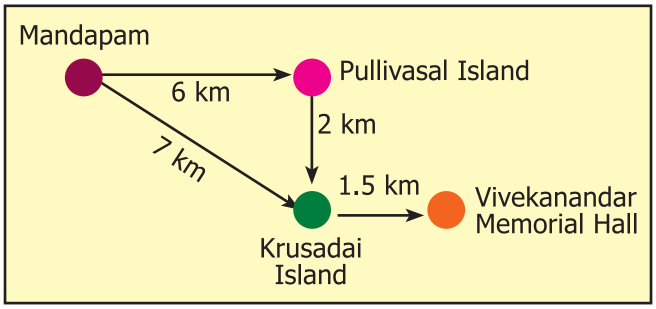
3. Shade the figure completely, by using five Tetromino shapes only once.



4. Using the given tetrominoes with numbers on it, complete the 4 x 4 magic square ?



5. Find the shortest route to Vivekanandar Memorial Hall from the Mandapam using the given map.



Challenge Problems

6. Fill in 4 x 10 rectangle completely, using all the five tetrominoes twice.

7. Fill in 8 x 5 rectangle completely, using all the five tetrominoes twice.

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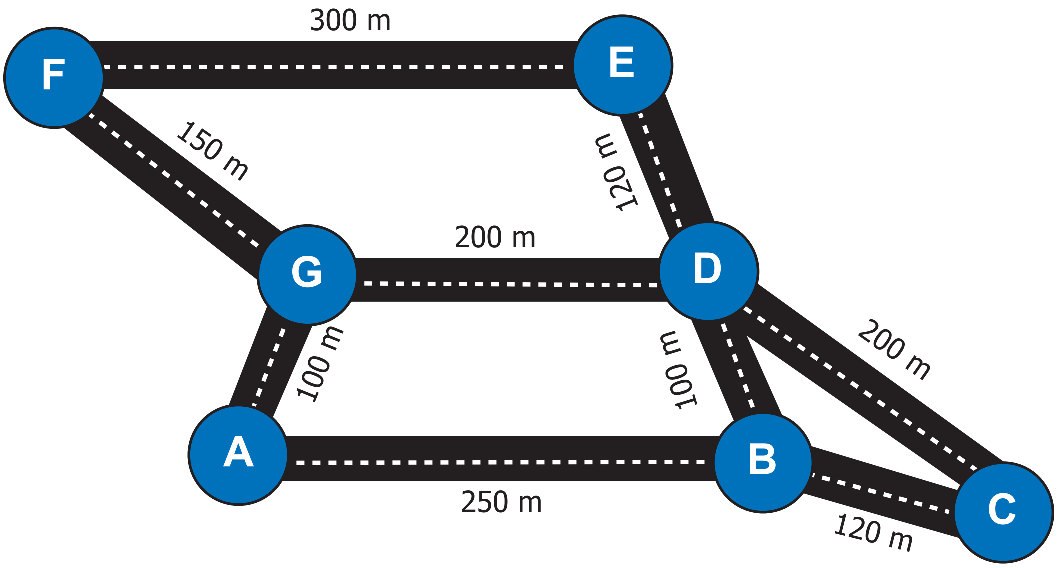
8. Observe the picture and answer the following.

(i) Find all the possible routes from A to D.

(ii) Find the shortest distance between E and C.

(iii) Find all the possible routes between B and F with distance. Mention the shortest route.



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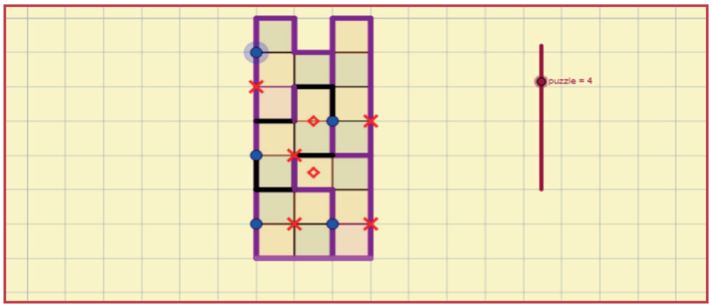
ICT Corner

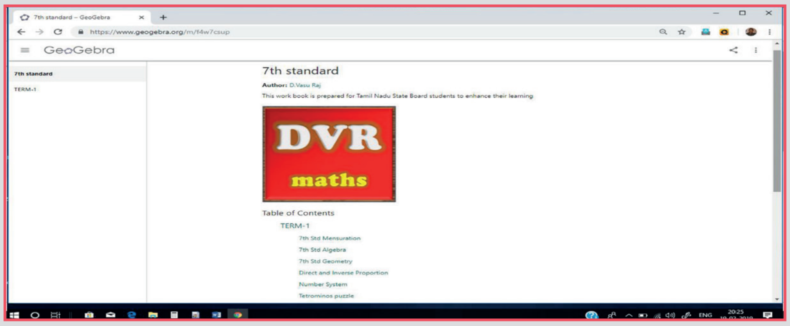
Expected Result is shown in this picture



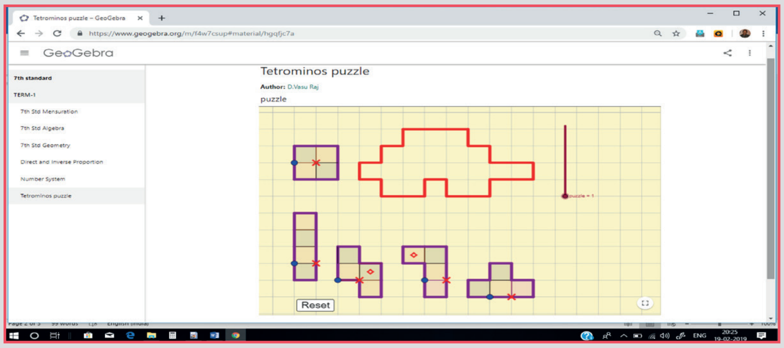
Step – 1 : Open the Browser type the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "7th std Information Processing" will open.

Step - 2 : There are several work sheets for each chapter. Select the worksheet "Tetrominoes Puzzle". Move the pieces to fit the given shape by dragging the blue points. Red cross can be selected to rotate the pieces. By moving the Red diamond you can flip the pieces. 'Reset' button is used to get back to original applet.

Step 1



Step 2



Browse in the link

Information Processing : https://ggbm.at/f4w7csup or Scan the QR Code.

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ANSWERS

Number System

Exercise 1.1

1. (i) 90 (ii) −95 (iii) −104 (iv) 22 (v) 140
   (vi) −100 (vii) 50 (viii) −171 (ix) −3 (x) 15, −42, −23
2. (i) False (ii) False (iii) True
3. (i) −4 (ii) −8 (iii) −110 (iv) −52 (v) 7 (vi) −63 (vii) −288
4. −38 5. Team A = Team B (yes, it can be added in any order)
6. Both are equal. Associative property under Addition
7. $0+2$, $1+1=2$, $-1+3$, $-2+4$, $-3+5$ (any pair)

Objective type questions

8. (iv) 10 pm 9. (i) −9+(−5)+6 10. (ii) −3 11. (iii) 0 12. (i) 20

Exercise 1.2

1. (i) −44 (ii) 30 (iii) −30
2. (i) False (ii) True (iii) False
3. (i) 1 (ii) 17 (iii) 99 (iv) −300
4. 3 5. 5th floor (above the ground floor) 6. 100°F
7. −2 8. Wrong, −35 (correct answer)

Objective type questions

9. (iii) 13 10. (ii) 0

Exercise 1.3

1. (i) 1 (ii) −2 (iii) −5 (iv) 5 (v) 0
2. (i) False (ii) True (iii) False 3. (i) '+' (ii) '−'
4. (i) −770 (ii) 1080 (iii) 3024 (iv) 0 (v) 10,000
5. (i) Not equal (ii) Not equal
   (iii) Equal ; distributive property of multiplication over addition
6. Decrease of 12inches
7. $(-5\times10), (-10\times5), (2\times-25), (-2)\times25,\ , (-1)\times50, (-50)\times1$

Objective type questions

8. (iv) (−6) × (+5) 9. (iii) distributive 10. (iv) −11 11. (i) 108

Exercise 1.4

1. (i) −1 (ii) −5 (iii) −36 (iv) 1
2. (i) False (ii) False

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3. (i) −15 (ii) 5 (iii) −5 (iv) −1

4. 9 5. dropped 3°c per hour 6. 53 minutes

7. 160 calories lost per day

8. 168 9. 5 10. −40

Objective type questions

11. (iv) $12 \div 5$ 12. (iii) $16 \div (-4)$ 13. (ii) − 20 14. (iv) division

Exercise 1.5

1. 14°c 2. (i) −2 (ii) 0 (iii) −3 (iv) −4 (v) 1

3. (i) -2°k (ii) 318°k (iii) -127°k (iv) 0°k

4. (i) ₹1175 (ii) ₹675 (iii) ₹325 (iv) ₹414 (v) ₹114

5. (i) 7 days (ii) 15,750 characters (iii) ₹8750
(iv) 5 days (v) ₹3,500 6. 12 7. Loss of ₹10

8. decrease of 18 inches 9. yes; 80 years

Exercise 1.6

1. 11 2. −40 3. −1,81,805 4. −445 5. −17,999

6. 31,500 7. −9 8. $(-3,-5)$, $(3,5)$

9. (i) Equal (ii) Not equal (iii) Not equal (iv) Equal

10. ₹ 6,800 11. The item x will be costlier is 2020

12. Match the following
1. d, 2. a, 3. e, 4. c, 5. b

Challenge Problem

13. (i) False (ii) False (iii) True (iv) True (v) False

14. −21 15. −5

16. $(-1)+1+(-2)+2+(-3)+3+(-4)+4+(-5)+5=0$
(The answer is not unique. You can take any single digit with its Additive inverse)

17. 2 18. (i) −4 (ii) −11 19. 3000 litres of water

20. 5 jumps 21. ₹ 24 22. 850 feet below the sea level

23. $x = 0$, $y = -4$, $z = -7$

Measurement

Exercise 2.1

1. (i) area $= 33$ $sq.cm$ perimeter $= 30\,cm$ (ii) area $= 70$ $sq.cm$ perimeter $= 40$ cm

2. (i) 90 $sq.cm$ (ii) 7 m (iii) 13 mm 3. 35 cm 4. 54 $sq.cm$ 5. ₹ 4620/-

Objective type questions

6. (iv) 22 cm 7. (i) 70 $sq.cm$ 8. (iii) 13 cm

9. (ii) Remains the same 10. (ii) 192 $sq.cm$

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Exercise 2.2

1. (i) 64 $sq.cm$ (ii) 165 $sq.cm$ 2. 126 $sq.cm$
3. (i) 152 $sq.cm$ (ii) 36 m (iii) 30 mm 4. 25 cm 5. ₹ 280

Objective type questions

6. (iii) 12 $sq.cm$ 7. (ii) 32 $sq.cm$ 8. (ii) 8 cm 9. (iv) 4 m 10. (iii) 90°

Exercise 2.3

1. (i) 160 $sq.m$ (ii) 24 cm (iii) 18 m (iv) 30 cm
2. 330 $sq.cm$ 3. 38 cm 4. 24 cm 5. 23 cm and 17 cm
6. ₹ 870 7. ₹ 697.50

Objective type questions

8. (i) 45 $sq.cm$ 9. (iv) 28 cm 10. (iii) isosceles trapezium

Exercise 2.4

1. 144 $sq.cm$ 2. 11 hm 3. 128 m 4. $h = 13\ cm$ $b = 52\ cm$
5. $d_1 = 48\ cm$ $d_2 = 24\ cm$ 6. ₹ 1,57,950

Challenge Problems

7. 45 cm; 25 cm 8. 4725 $sq.cm$ 9. 192 $sq.cm$ 10. $DF = 30\ cm$ $BE = 42\ cm$
11. 54 $sq.cm$ 12. 169 $sq.cm$; ₹ 2535
13. 12 cm 14. ₹ 5250 15. 324 $sq.m$

ALGEBRA

EXERCISE-3.1

1. (i) x (ii) –6 (iii) unlike (iv) three (v) –1
2. (i) True (ii) False (iii) True (iv) False 3. –3,12, 1,121, –1,9,2.
4.

S.No.	Expression	Variable	Constant	Terms
(i)	$18 + x - y$	x, y	18	$18, x, -y$
(ii)	$7p - 4q + 5$	p, q	5	$7p, -4q, 5$
(iii)	$29x + 13y$	x, y	0	$29x, 13y$
(iv)	$b+2$	b	2	b, 2

5.

x – terms	y – terms	z – terms
$7x, -8x, -12x$	$5y, 12y, -9y$	$6z, z, 11z$

6. (i) –5 (ii) 5 (iii) 10 (iv) 0

Objective type questions

7. (i) $3(x+y)$ 8. (ii) –7 9. (iv) $-4x, 7x$ 10. (ii) 13

EXERCISE-3.2

1. (i) $-5b$ (ii) $-8m$ (iii) $37xyz$
2. (i) False (ii) False (iii) True

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3. (i) $11x$ (ii) $12mn$ (iii) $4y$

4. (i) $8k$ (ii) $10q$ (iii) $10xyz$

5. (i) $28p+6q$ (ii) $3a+15b+16c$ (iii) $6mn-4t$ (iv) 6u (v) $8xyz-8xy$

6. (i) $14x-7y-38$ (ii) $-2p-2q+2$ (iii) $2m-8n$ (iv) $-7y+5z$

7. (i) $-10x-11y+12z$ (ii) $2p+6$ (iii) $3m+3n+15$

Objective type questions

8. (iii) $2mn$ 9. (iii) $-2a$ 10. (i) Like terms

EXERCISE-3.3

1. (i) equation (ii) 15 (iii) $6x$

2. (i) False (ii) True (iii) True

3. (i) $x=3$ (ii) $p=10$ (iii) $x = 15$ (iv) $m=30$ (v) $x=10$

4. $2x+2y$ 5. $x=12$ 6. 99 and 101 7. $x=45km$

Objective type questions

8. (iii) $3n$ 9. (i) 2 10. (ii) -1

EXERCISE-3.4

1. $6ab+16;\ -6ab-16$ 2. $4x+3y$ 3. $x=13$ 4. $3ab-7b+3c$ 5. $x=8$

Challenge Problems

6. $12x+6y-18$ 7. $-4a-b-4c$ 8. $5m+n-6$ 9. $lb-2(l+b)=20$

10. $3a+\frac{4}{3}b+\frac{17}{5}c$

Direct and Inverse Proportion

Exercise 4.1

1. (i) ₹ 84 (ii) $21kg.$ (iii) 10 litres (iv) ₹ 210 (v) 360

2. (i) True (ii) True (iii) False (iv) True (v) False

3. ₹ 80 4. 42 5. 180 6. 40 m 7. 1107

8. ₹ 250 9. 5 $kg.$ 10. ₹ 30,000 11. 10 days

12. Kamala 13. 5 litres

Objective Type Questions

14. (iii) ₹ 360 15. (ii) 7 16. (iv) 147 17. (ii) 10 18. (i) 9

Exercise 4.2

1. (i) 32 (ii) 80 2. 1 hour 48 minutes

3. 36 days 4. 20 days 5. 15 days 6. 100 gm

7. 18 8. 4 km/hr 9. 24

Objective Type Questions

10. (iii) 6 11. (ii) 8

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Exercise 4.3

1. (i) 15 kg. (ii) ₹ 36 2. (i) Direct proportion (ii) k = 5 (iii) C = 50
3. 90 months 4. 12 minutes 5. ₹ 140 6. 3 7. 300 litres

Challenge Problems

8. ₹ 1155 9. 35 minutes 10. 81 11. 6 days 12. 10 days 13. 5 days

GEOMETRY

Exercise 5.1

1. The pairs of adjacent angle are $\angle ABG$ and $\angle GBC$, $\angle BCF$ and $\angle FCE$, $\angle FCE$ and $\angle ECD$, $\angle ACF$ and $\angle FCE$, $\angle ACF$ and $\angle FCD$.
2. 65° 3. 86° 4. (i) 108° (ii) 46° (iii) 30°
5. The other angle is also a right angle. 6. 30°, 120°, 210° 7. 63°
8. Adjacent angles: $\angle PQU$ and $\angle PQT$, $\angle PQT$ and $\angle TQS$, $\angle TQS$ and $\angle SQR$, $\angle SQR$ and $\angle RQU$, $\angle RQU$ and $\angle PQU$ (all possible answers).

   Vertically opposite angles: $\angle PQU$ and $\angle TQR$, $\angle PQT$ and $\angle UQR$.
9. 120° 10. 105° 11. 45°, 135° 12. (i) 125° (ii) 55°

Objective type questions

13. (iii) one common arm, one common vertex, no common interior
14. (iii) linear pair 15. (iv) equal in measure
16. (i) 360° 17. (ii) 80°

Exercise 5.2

1. (i) The angles are exterior angles on the same side of the transversal

   (ii) The angles are alternate exterior angles

   (iii) The angles are corresponding angles

   (iv) The angles are interior angles on the same side of the transversal

   (v) The angles are alternate interior angles

   (vi) The angles are corresponding angles
2. (i) 35° (ii) 65° (iii) 145° (iv) 135° (v)90°
3. (i) 28° (ii) 58° (iii) 123° (iv) 108°
4. (i) 149° (ii) 45° (iii) 101° (iv) 158°
5. (i) 42° (ii) 8° (iii) 2° (iv) 15°
6. (i) 55° (ii) 35°
7. (i) No. Since, interior angles on the same side of the transversal are supplementary.

   (ii) No. Since Corresponding angles are equal.
9. Minimum number of angles is 1. Using the concept of linear pair of angles, we can find one more angle and by the concepts of corresponding angles and alternate angles (interior and exterior) we could find all other angles.

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Objective type questions

10. (ii) transversal   11. (i) alternate exterior angle

12. (iv) interior angles on the same side of the transversal are supplementary

13. (ii) 44°

Exercise 5.6

1. 18°   2. 41°   3. 35°, 115°, 25°   4. 55°, 125°

5. (i) Yes. They have a common vertex, a common arm and their interiors do not overlap.
   (ii) No. They have overlapping interiors.
   (iii) No. Since ∠BOC is a straight angle, their sum will exceed 180°.
   (iv) Yes. They are linear pair.
   (v) No. They are not formed by intersecting lines

6. 52°   7. 30°, 80°   8. 75° , 42° , 42°

9. 90°   10. 127°

Challenge Problems

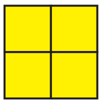
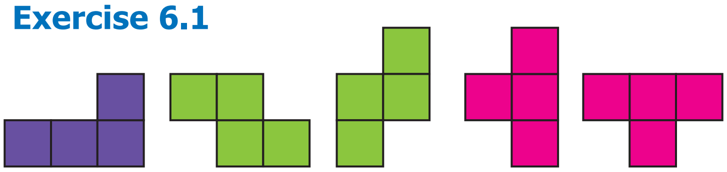
11. 26°   12. 38°   13. 40°,25°   14. 44°

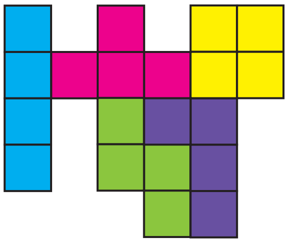
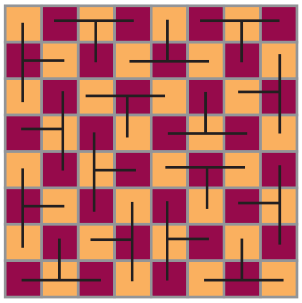
15. 72°,57°,51°   16. 76°,29°   17. 7°   18. 48°,60°,108°

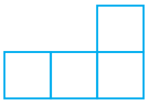
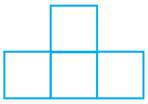
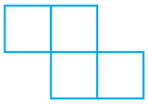
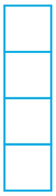
19. 21°   20. 214°

Information Processing

Exercise 6.1

1. 4   2.    3. 

4.    5.  (more possible ways)

6. (i)  (ii)  (iii)  (iv) 

7.

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

(more possible ways)

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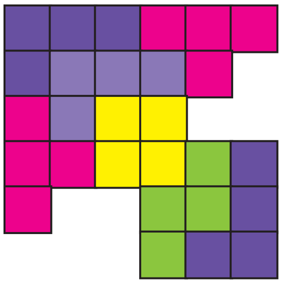
Exercise 6.2

1.



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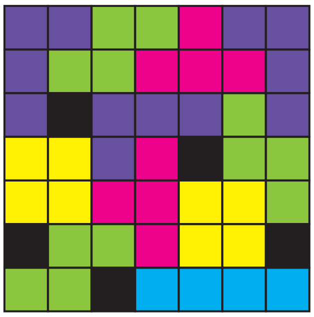

(more possible ways)

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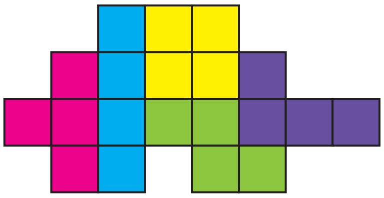


4.

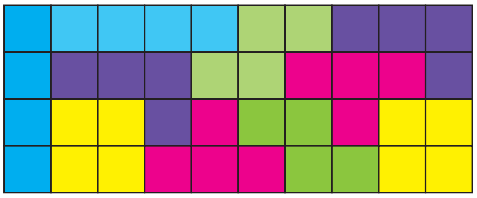
16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

(more possible ways)

5. Mandapam → Krusadai Island → Vivekanandar Memorial Hall

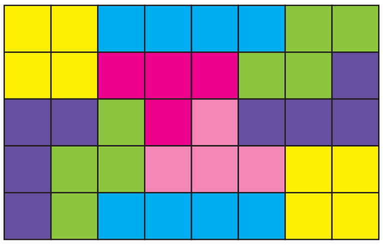
Challenge Problems

6.



(more possible ways)

7.



(more possible ways)

8 (i) $route 1 \quad A \to G \to D$

$route 2 \quad A \to B \to D$

$route 3 \quad A \to B \to C \to D$

$route 4 \quad A \to G \to F \to E \to D$

(ii) $320\ m$

(iii) $route 1 \quad B \to A \to G \to F$

$250 + 100 + 150 = 600 m$

$route 2 \quad B \to D \to E \to F$

$100 + 120 + 300 = 520 m$

$route 3 \quad B \to D \to G \to F$

$100 + 200 + 150 = 450 m$

$route 4 \quad B \to C \to D \to E \to F$

$120 + 200 + 120 + 300 = 740 m$

Route 3 is the shortest route.

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GLOSSARY

Additive Identity	கூட்டல் சமனி
Additive Inverse	கூட்டல் எதிர்மறை
Adjacent angle	அடுத்துள்ள கோணங்கள்
Adjacent sides	அடுத்துள்ள பக்கங்கள்
Alternate exterior angle	ஒன்றுவிட்ட வெளி கோணங்கள்
Alternate interior angle	ஒன்றுவிட்ட உட்கோணங்கள்
Alternate	ஒன்றுவிட்ட
Angle bisector	கோண இருசமவெட்டி
Associative property	சேர்ப்புப் பண்பு
Base	அடிப்பக்கம்
Closure property	அடைவு பண்பு
Co-efficient	கெழு
Commutative property	பரிமாற்றுப் பண்பு
Compare	ஒப்பீடு
Constant	மாறிலி
Corresponding angles	ஒத்த கோணங்கள்
Diagonal	மூலைவிட்டம்
Distributive property	பங்கீட்டுப் பண்பு
Equation	சமன்பாடு
Formation	உருவாக்குதல்
Generalize	பொதுமைப்படுத்து
Height	உயரம்
Horizontal	கிடைமட்டம்
Integers	முழுக்கள்
Interior of an angle	கோணத்தின் உட்பகுதி
Isosceles trapezium	இரு சமபக்கசரிவகம்
Like terms	ஒத்த உறுப்புகள்
Linear equations	நேரியச் சமன்பாடுகள்
Linear pair of angle	நேரிய கோண இணைகள்
Multiplicative Identity	பெருக்கல் சமனி
Negative Integers	குறை முழுக்கள்
Non-adjacent angle	அடுத்தடுத்தமையாக் கோணங்கள்
Numerical value	எண் மதிப்பு
Numerical co-efficient	எண் கெழு
Parallel sides	இணை பக்கங்கள்
Parallelogram	இணைகரம்
Pattern	அமைப்பு
Perpendicular	செங்குத்து
Perpendicular bisector	செங்குத்துச் சமவெட்டி
Positive Integers	மிகை முழுக்கள்
Properties	பண்புகள்
Puzzle	புதிர்
Recall	நினைவுகூர்தல்
Regulation	ஒழுங்குமுறை
Rhombus	சாய்சதுரம்
Sequence	தொடர்வரிசை
Showcase	காட்சிப்பேழை
Substitution	பிரதியிடுதல்
Terms	உறுப்புகள்
Tetromino	நான்கு சதுரங்கள் இணைக்கப்பட்ட வடிவம்
Tokens	வில்லைகள்
Traffic	போக்குவரத்து
Transversal	குறுக்குவெட்டி
Trapezium	சரிவகம்
Undefined	வரையறுக்க படாதது.
Unlike terms	ஒவ்வா உறுப்புகள்
Variable	மாறி
Vertex	முனை (அ) உச்சி
Vertically	செங்குத்தாக
Vertically opposite angles	குத்தெதிர் கோணங்கள்

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This book has been printed on 80 GSM
Elegant Maplitho paper

Printed by offset at :

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